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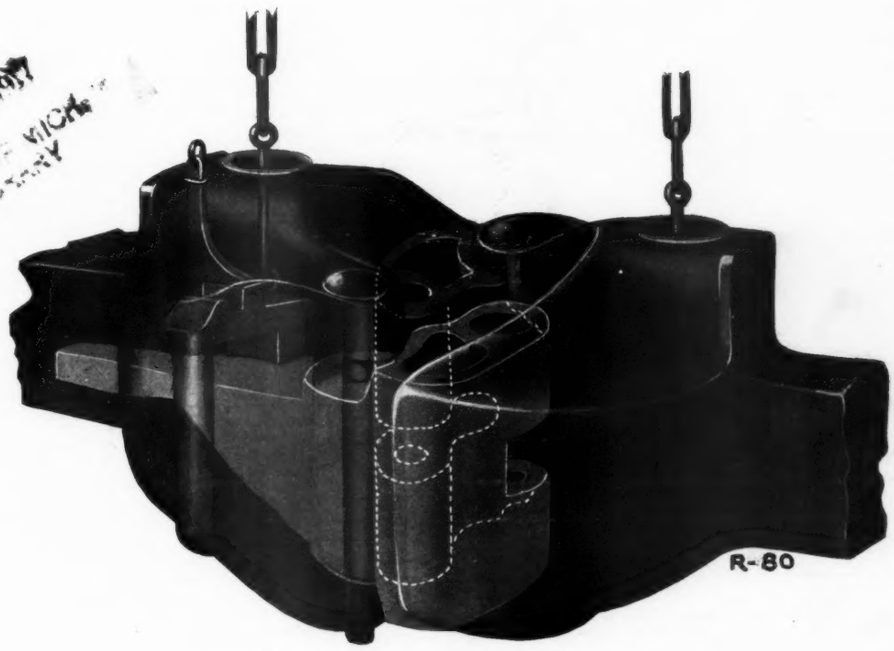

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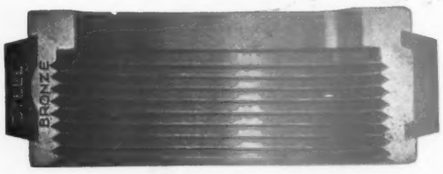

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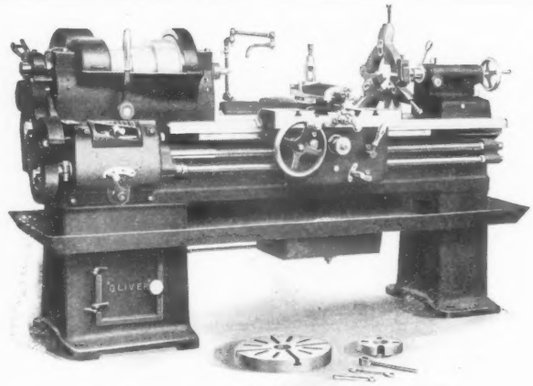

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Railway Mechanical Engineer

Volume 91 December, 1917 No. 12

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The American Society of Mechanical Engineers' Meeting

It is with regret that we find that at its annual meeting the American Society of Mechanical Engineers abandoned its previous practice of holding a railroad session. Now, if never before, does the country, and the railroads in particular, need all the possible assistance of the technical societies. The railroads are sadly in need of more power. New power cannot be purchased and the old power must be improved. There are engineers in this society who are able from their experience and study of locomotive problems to give valuable and concrete information as to what might be done to make the locomotives more effective. The locomotive situation is serious. The railway mechanical department needs all the assistance it can get, and again we say, it is with regret we find the greatest organization of mechanical men in this country letting such a golden opportunity for being of real assistance to the railroads pass without a word.

Railway Equipment Situation in Russia

A report of an interview with Henry Miller, who went to Russia in June as a member of the United States Railway Advisory Commission, which was published in a recent issue of the Railway Age Gazette, gives us a clearer view of the true railway situation in Russia than anything we have yet had. There are about 20,000 locomotives, most of them compounds, whose average age is 24 years. They have an average tractive effort of 18,000 lb. and 10 per cent burn wood, 5 per cent oil and the balance burn coal. About 15 per cent of the power was found to be in bad order when the committee arrived at Petrograd. Investigation showed that 2,500 additional locomotives were necessary adequately to handle the increased traffic due to the war.

The need for cars was not so great. Of the 580,000 freight cars having an average capacity of 16 tons, 8 per cent were in bad order. The committee recommended the addition of 40,000 new cars which with the locomotives were supposed to be supplied by the United States. An interesting feature of the Russian freight cars is that only about 20 per cent are equipped with brakes and only 13,000, which were built in America, have air-brakes. The braking is generally done by hand, the practice being to use a brake van or car for every fifth car in a train and to station a brakeman at each brake.

The method of train operation in Russia is particularly interesting. Mr. Miller stated that there is almost an entire absence of what in America is termed the operating department. It was the practice before the commission's suggestions were put into effect, to operate the engines and crews on short turn-around trips. The men were assigned to regular locomotives, which practice resulted in a very small mileage for each locomotive; because when the men needed rest or laid off on account of sickness or for other causes the locomotives were also taken out of service. By pooling the men and the locomotives the commission doubled the locomotive mileage and most of the congestion was cleared up by the end of August. The commission further divided the lines into 300 mile divisions, each in charge of a superintendent and a staff of 13 assistants, including trainmasters, despatchers, master mechanics, traveling engineers, etc. Some 350

experienced railroad men have been sent from this country to carry out the recommendations of the committee and to instruct the Russian railway men in American railway operating methods.

The recent change in the Russian conditions may, of course, affect the extent to which the United States will cooperate with that country.

More Motive Power Capacity

The transportation machinery of the railroads of this country is handicapped for the lack of motive power. New locomotives cannot be obtained. The only thing that remains is to get more power from the existing locomotives. Some roads are doing this by the addition of boiler capacity increasing devices which enable them to haul trains at greater speeds, or by the enlarging of the cylinders to haul greater loads. One road in particular has made material increases in the tonnage rating of its locomotives by doing this. Another road is making a careful study of its entire power to see how far it can go to make the locomotives do more work. Still another road has by making careful tests of its standard locomotives, both on a stationary testing plant and on the road, found how it can increase the power of these locomotives with but minor changes in design, with an accompanying saving in the cost of operation of thousands of dollars.

With conditions such as they are, every effort should be made to do more work and haul greater train loads. Of particular importance is the tonnage rating given the locomotives. Cases without number have been found where either due to ignorance or carelessness the locomotives have not been given a tonnage rating as high as they are able to handle. It is here that the road foreman of engines may prove of invaluable assistance. There are instances where by more thorough instruction and supervision of locomotive operation, engines have been made to haul from six to seven per cent greater tonnage, which means that 16 locomotives will do the work of 17. The General Operating Committee for the Eastern Roads recommends that freight traffic on fast or reduced tonnage rating be suspended and that hereafter this freight be operated on full tonnage continuous movement schedules. This shows how necessary it is to load the power to its maximum and this maximum must be the real maximum, which can only be obtained by an accurate rating of the locomotives. As the capacity of these locomotives is increased by the addition of capacity increasing devices, they should be re-rated and made to do their utmost. This is where the mechanical engineers and mechanical staff officers can do their "bit," in the struggle which this country has entered into.

The Duty of the Men at Home

It sometimes becomes very apparent that many of those who are secure in their homes with a fat pay envelope coming in regularly and plenty of work to insure a continuance of this prosperity for some time to come, do not fully appreciate what this terrible war means to us individually. If the Allies should not win this war it means that the German government with all its ambitions for world power will be a constant menace to the principles which we love and for which our forefathers fought. It is the duty of every man, woman and child in this country to do what he can to aid the government. This includes the conservation of foodstuffs, fuel and materials of all kinds. It means that every one must do his work more efficiently, more perfectly and more intensively.

Press despatches indicate how serious the transportation situation in this country is. Railroad men know further that the lack of sufficient and efficient motive power is one of the main contributory causes to the railroads' difficulty. Without adequate transportation facilities the work of this country in the war will be greatly handicapped. The motive power department is coming into prominence because of inadequate and insufficient power more than it ever has before. Never have such great demands been made upon the men working in this department.

The work of repairing locomotives is hard and many times it has to be done under the most trying conditions. The men need all the encouragement and moral support they can get from their leaders. It is the duty of the supervising officers and foremen to give this in full measure. They must make the men thoroughly realize what their services mean to the railways and to the country. The men themselves must make sacrifices, as many of the railroad units are making in France. In addition to their hard labors at the front, despatches show that the railroad forces are ready to pick up arms and sacrifice their lives to repel the common enemy. They are giving all they can give. What a lesson it is for us at home! All the government asks of us is work—good, hard conscientious work—and it is the least we can do to give this in full measure and back up the boys who are sacrificing their lives for us. Make every man realize that he has a duty to perform and that even though his work is not of a spectacular nature, it is extremely necessary. By doing this we will have far more contented men, far more efficiently maintained power and an esprit de corps which will help the railways to make good.

Locomotive Boiler Inspector's Report

The sixth annual report of the chief inspector of locomotive boilers for the Interstate Commerce Commission has recently been made public and is abstracted elsewhere in this issue. There is this year an increase in the percentage of locomotives found defective and an increase in the number of accidents and casualties. Some of this increase is due to the fact that during the fiscal year 1917 the records include those concerning the entire locomotive and tender, while during the fiscal year of 1916 only about ten months include the entire locomotive. The chief inspector says, "The increase has no doubt been brought about by unprecedented operating conditions which, together with the shortage of labor and material, has made difficult the proper maintenance of locomotives." In addition to this we believe that due to the shortage of power, locomotives which under ordinary conditions would have been scrapped and replaced, have been put into operation without being properly inspected and properly repaired. The need for power should not be taken as an excuse for putting in service locomotives which are not in a safe condition to run.

The chief inspector also says that, "The fact that some carriers by diligent efforts and careful supervision of repairs have not only maintained the condition of their locomotives, but have actually improved it during the past year, thereby increasing operating efficiency, is evidence that it can be done under the present exacting operating conditions." We fully agree with this statement. Those roads that have done this have been doing their country a service and will be the ones to hold up the reputation of the railroads during the oncoming winter. Those roads that do not do this are living on their vitals and are, so to speak, slowly starving to death. Mention is made of this condition in the report, the inspection bureau having found that some railroads have been woefully neglectful of the running repairs.

Of the classified accidents mentioned in the report, the greatest increase was found in those pertaining directly to the boiler or its appurtenances. Mention is made in the report of the fact that much trouble is experienced, particularly on the old power with the specification card showing

the strength of boilers when patches have been applied or alterations made to them, cases having been found where locomotives were in service carrying much higher pressure than they should. It is such carelessness as this that causes the accidents and makes it necessary for the Federal inspectors to hold the power out of service.

Many of the accidents investigated by the inspection bureau indicate that they might have been avoided had reasonable inspection been made of the work and had the work been properly done. Supervision and inspection, as never before, are tremendously important factors at this time. The chief inspector lays particular stress on this fact and rightly so, for it is only by this means that the power can be kept in good condition.

The National Fuel Problem

The condition of the fuel market in this country is such as to affect practically every citizen. It is no longer an individual problem—it is a national problem. We have got to conserve our fuel supply in order that others may live. There are four particular uses to which fuel is put that are under the direct influence of railroad men. The first and of greatest importance is the fuel used on locomotives. Next comes the fuel for providing power in shops. The third is the fuel used for lighting and heating railway buildings. The fourth is the fuel used in the home for domestic purposes. The situation is so serious that every one of these problems must be given consideration.

Fuel economy on locomotives is a subject that is not new to any of us. There is hardly a railroad in this country but has given it serious consideration. It has a new aspect, however. The much higher price of fuel requires an entire revision of the fuel economy campaign. With the railroad fuel bill $100,000,000 or more greater than it was last year, the railroads can well afford to spend more money than they have to decrease the fuel consumption of their locomotives. Further than this it is their patriotic duty to do so. Making the coal evaporate more water, by making the locomotive boiler transfer more heat to the water, and by making the steam do more actual work in the cylinder means cutting down the fuel required. There are many ways of doing this—bring your locomotives up to date, maintain them properly and keep the boilers free from scale. With a good machine to work with the engine crew will learn a lot and will do their part, if properly instructed, towards the saving of fuel.

The shop is a fuel eater, but compared with the locomotive consumption is of but little importance. It requires a large amount of fuel, however, to keep it running. The losses there would on most railways be startling if they were known. See that the power plant is run properly. The railroad stationary power plant is notoriously inefficient. Remember that one manufacturing city has prohibited the use of shop whistles for calling the men to work, simply to save the coal which would be used to generate the steam for blowing them. That is how much coal means to some. See that the shop engines are working efficiently. Lubricate the line shaft and machines properly. Don't run machines unnecessarily. Have everybody in the shop appreciate the fact that wasted power means wasted fuel.

The lighting and heating requirements are also comparatively small, to be sure, but economy here will help. We must have sufficient light to work by and too often on a railroad it is insufficient, but when there is no need for a light it should be extinguished. Carry the thought of a prominent man in the railroad field as he went back to turn out the lights in his hotel room—"It will save the fireman's back." It will also save fuel. It is not what one of us does, but what all of us do—so issue instructions about leaving unnecessary lights burning. The fuel used in heating, particularly in the offices, is almost never given the slightest thought, except perhaps when the boiler plant fails and the temperature is low. Generally it is the open window or the coatless man that keeps one from a turkish bath. Why not repair the valves in the radiator and turn the heat off? It will save coal!

The fuel problem at home interests us all. If we have the money to pay for coal we are fortunate if we can get it. Here we economize of necessity. It means so much to the people in the state of New York that the governor has issued a proclamation calling on the domestic users to save coal. This has been supplemented by instructions relating to the economical handling of household heating plants. Let the lesson you must learn of necessity at home be a guide to you in your work, whether you run an engine, or work in the shop or at a desk—Save Coal!

Enginehouse Terminal Competition

The response we have received to our call for papers relating to methods by which the performance at engine terminals may be improved has been gratifying. There were 13 papers contributed to this competition, all of which are good and most of them will be published in future issues. The papers awarded the prizes are published elsewhere in this issue. The judges based the awards on the constructive suggestions in the papers. Some of the contributors merely described existing organizations, which although they were interesting, where not just what was desired in the present case. Perhaps the most important thought brought out in all the papers submitted was the necessity for careful supervision of the work done at engine terminals and a thorough inspection of the power. Suggestions were made also for alterations or additions to terminals which may be readily made without interfering too much with the operation of the terminal.

Now, if never before, the power should be turned out of an engine terminal with the full assurance that it will do its work properly and reach the end of its run without delay. "Congestion" is on every railroad man's lips; we hear it everywhere. Congestion can only be relieved by moving the freight. The locomotives, therefore, are the key to the situation. They must be kept in repair, they must be kept efficient and they must be made more efficient if the railroads are to meet successfully the demands made upon them today. We are just starting on the worst season of the year. We have no reserve of power; there is nothing to fall back upon if our locomotives fail. They must be kept on the road as much as possible.

The burden which is now resting upon the enginehouse forces is great and the work they do is tremendously important. Every means must be taken to increase the efficiency of these men. Where an organization is weak, it should be strengthened. Supervision is of prime importance. It is only human nature for men to do only that which they have to do. If the standards are high, they meet them; if the standards are low, they meet them also, and do but little more. Supervision is the only means by which the standards can be raised and maintained. It will be money well spent to split the enginehouse force into gangs with an active and progressive leader at the head of each to see that the work is done properly. An organization well supervised can do more work with fewer men than a group of men working under no organization at all.

The enginehouse forces are working under a great deal of strain. In many places they are required to work out in the open with but little protection from the elements. Their work is very hard and trying. They must be encouraged by their leaders and made to realize how much depends upon them. Where it is possible, improvements should be

made, if of only a temporary character, to make their work easier and to assist them in putting the locomotives through the terminal with greater despatch. Inspection pits are of considerable importance and great assistance. Engine washing plants, such as have been described previously in these columns, assist greatly in keeping the engines clean so that they may be inspected more easily. An additional water plug here or there throughout the terminal may mean the saving of more cross switching or back hauling. Ash pits might be lengthened and locomotive cranes with clam shell buckets kept in readiness to clean the pits whenever they become full. Special jigs or devices in the house are necessary to facilitate doing the work. These should be installed without a question. There are many other things that may be done to make the work of this important branch of the service easier and the wide-awake enginehouse foreman will be on the lookout for just such things as these.

The railroads are short of power and will be shorter as the winter progresses. Therefore, make every man in the enginehouse organization realize how much depends upon him. He is the man on the firing line. It is his work that to a large degree will determine whether or not the railroads will successfully meet the exacting demands made upon them.

NEW BOOKS

Carnegie Shape Book. c52 pages, 5 in. by 7¾ in., illustrated, bound in leather. Published by the Carnegie Steel Company, Pittsburgh, Pa. Price, $1.

In continuation of its previous practice, the Carnegie Steel Company has revised its shape book and is now presenting the sixth edition. In this edition the pages devoted exclusively to profiles of sections have been increased to 265 pages, in contrast to 227 pages which were given to this department in the fifth edition, published two years ago. The increase in the number of sections made standard by this company is due to the remarkable expansion in shipbuilding, to the extensive use of steel crossties for industrial and railway purposes, to the increase in the automobile industry, and particularly to the great development in the use of steel in frames for windows, door and skylights in modern factory buildings. The customary tables of weights of different shaped material are included. The book has a complete subject index.

Compressed Air for the Metal Worker. By Charles A. Hirschberg. 315 pages, 6 in. by 9 in., illustrated, bound in leather. Published by the Clark Book Company, 27 William street, New York. Price $3 net.

This book has been written by the author for the purpose of gathering together under one cover practical information relating to the uses of compressed air. He has undertaken to confine himself to a discussion of the practical side of compressed air utilization and to tell the *how* and *why*. Where theory has been referred to it is discussed concisely and in non-technical language. The book has been written for shop owners, superintendents, foremen and machinists or other artisans. The subjects covered may be classified under power plants, factories, machine shops, forge shops, boiler and structural shops, etc. The first chapter covers in a historical way the progress made in compressed air advancement. This is followed by a discussion of the compressed air power plant, in which is given practical information regarding such plants for the benefit of those planning to make such installations. The details of the compressor and compressor accessories are also given with many illustrations, in a clear and interesting manner. Further information is given regarding the installation and care of compressors with their accessories. The author then discusses various tools and their uses, which can be operated by compressed air, this comprising the greater part of the book.

COMMUNICATIONS

EDUCATE THE TRAINMEN

Baltimore, Md.

To the Editor:

I have read with a great deal of interest R. J. Quintrell's communication entitled "A Protest! Educate the Trainmen" in your issue of November, 1917.

In these strenuous days when the railroads are called upon to handle an inconceivable increase in tonnage, with a very small increase in rolling stock, the cry has been sent forth to the mechanical department to do its duty to its country in keeping the trains moving. And this is as it should be. But Mr. Quintrell has touched a chord, which, if fully developed, will produce a sound well worth listening to. I have personally observed a number of times wanton destruction of railroad property by rough handling of trains, especially in switching. The resultant delays in switching out damaged equipment has more than offset any saving in time by rush operations, to say nothing of the expense in repairs incident thereto. Far too many times the break-in-twos on the road find their initial cause in the classification yards. I have known of instances where switching crews were required to handle a specified minimum tonnage daily, and the number of damaged ends was mute testimony to the manner in which this tonnage handling was accomplished.

A little talk now and then on the results of rough handling, giving figures to show the approximate cost of repairs to damaged equipment, and the loss of revenue from rolling stock standing idle on the repair tracks, together with suggestions regarding proper handling of cars, might go far toward solving our transportation problems, which are daily becoming more difficult. Arthur W. Norton.

THE WORK OF THE MEN AT HOME

Colonie, N. Y.

To the Editor:

I have noted with much interest the move made by the supply men to furnish "tobacco" to the men of the engineer regiments. You will be interested in an organization we have formed in the Delaware & Hudson shops at Colonie, N. Y.

We have given about 70 of our men to army or navy, some to the engineer regiments and many to other parts of the service. Realizing that we at home also have a duty to perform, after sounding the sentiment of the shop, at a noon hour meeting, an organization was formed comprising practically to a man the full shop quota. Its purpose is:

(1.) To furnish periodically—approximately once each month—while the war lasts, to each fellow Colonie man enlisted in the nation's service, tobacco or some token of remembrance, together with a shop letter.

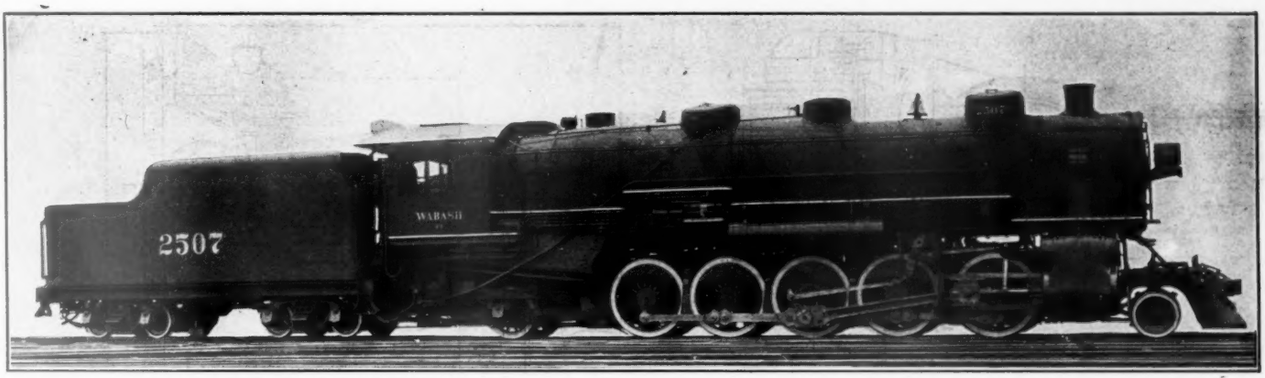
(2.) To keep in touch with those left at home who may be wholly or partially dependent on our fellow Colonie men at the front to the end that where a helping hand may be needed it will unobtrusively be extended.

(3.) By these means—to give to our men the encouragement had with the knowledge that we are back of them to a man, evidencing clearly our realization that the problem is a mutual one.

We have also placed an honor board in a conspicuous place, giving the location of the men in the service. Committees were formed as follows: Honor Roll, Purchasing, Reading, Home Letters, Helping Hand and Printing.

Don't you think that if every shop in the United States did the same it would be a splendid thing?

G. S. Edmonds,
Shop Superintendent.



WABASH 2-10-2 TYPE LOCOMOTIVE

Exceptionally Large Boilers Make Possible High Sustained Capacity; Rated Tractive Effort 69,700 lb.

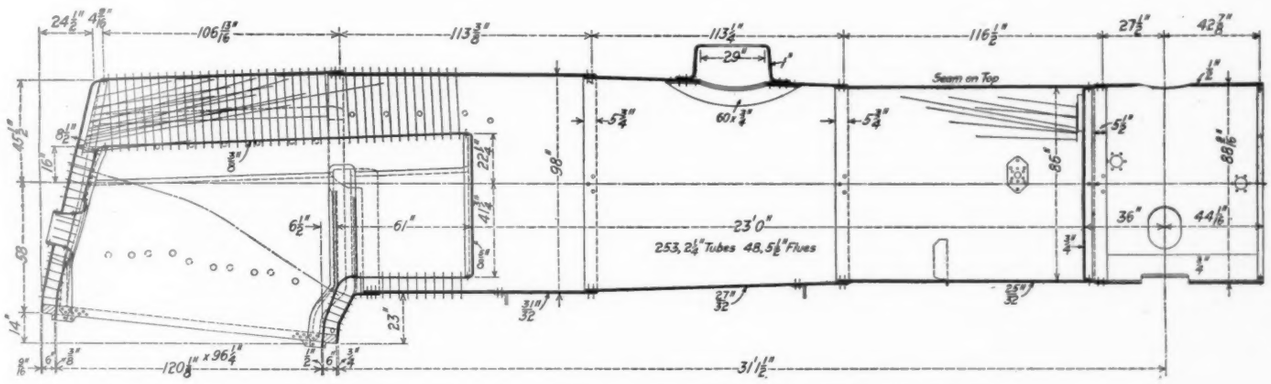
THE Wabash Railway has recently received 25 large 2-10-2 type locomotives from the American Locomotive Company. These engines have replaced others of the Mikado type on the Decatur division between St. Louis, Mo., and Chicago.

On this division the heaviest traffic is in the northbound direction, against which the ruling grade is .4 per cent, with the longest single grade four miles in length. The average train load for the 2-10-2 type locomotives northbound is 5,000 tons, as compared with 3,500 tons for the Mikado type locomotives previously in service in the same territory. This is an increase for the 2-10-2 type of 42.8 per cent in tonnage and a decrease of 30 per cent in train mileage has thereby been effected. These locomotives have been used on troop trains with very satisfactory results, hauling as many as 30 cars at speeds of 35 miles an hour. The exceptionally large boilers and the mechanical stokers with which the locomotives are equipped have made this exceptionally high sustained capacity possible of attainment.

The new locomotives have cylinders 29 in. by 32 in. and a tractive effort of 69,700 lb., with driving wheels 64 in. in diameter. The total weight of the engine and tender is 591,900 lb. The Mikado type locomotives displaced by the new engines have cylinders 26 in. in diameter by 30 in. stroke and a tractive effort of 50,360 lb. The total weight of engine and tender is 423,800 lb. With an increase in total weight of 39.6 per cent, an increase in tractive effort of 38.4 per cent has been obtained and the train load has been increased 42.8 per cent.

As a rule, an increase in weight results in a proportionately greater increase in tractive effort. In this case, however, the percentage increases in weight and tractive effort are approximately the same because of the particular attention which has been given to the proportioning of the boiler. It is of the extended wagon top type with an outside diameter at the first barrel course of 87 9/16 in. The largest barrel course has an outside diameter of 98 in. The boiler is fitted with 253 tubes, 2¼ in. in diameter, and 48 superheater flues, 5½ in. in diameter. The length between tube sheets is 23 ft.

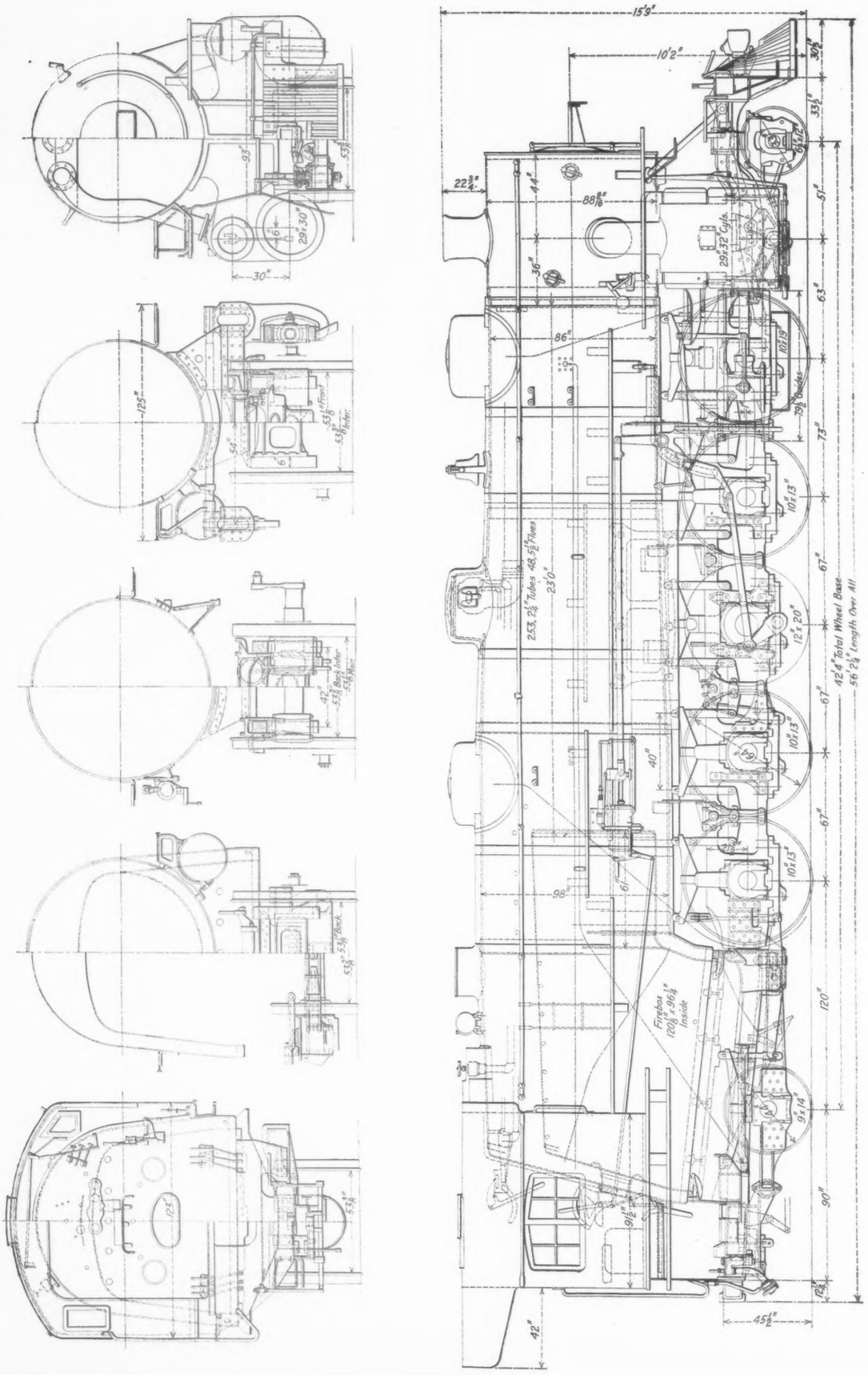
The firebox has a grate area of 80.2 sq. ft. and is fired by the Street Duplex stoker. It is 120⅛ in. long and 96¼ in. wide and is fitted with a Security brick arch carried on five arch tubes.



Longitudinal Section of the Boiler for the Wabash 2-10-2 Type Locomotive

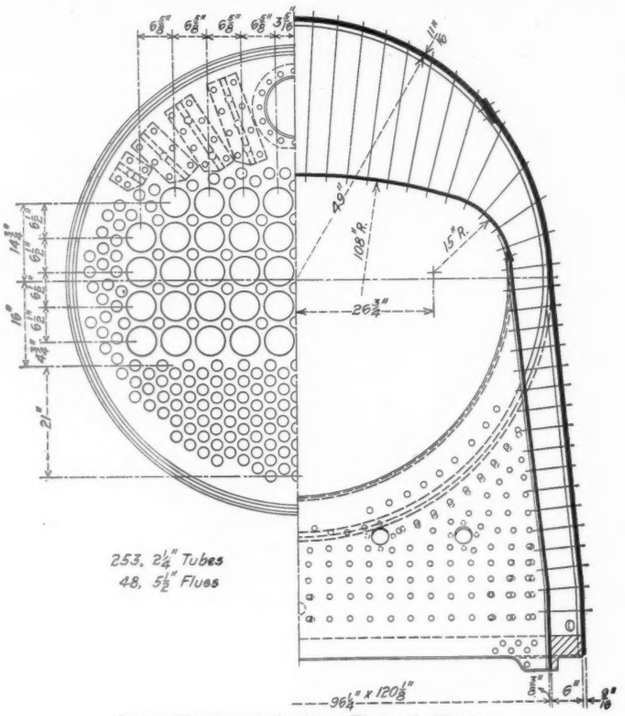
The heating surface of the firebox and arch tubes is 379 sq. ft. and the total evaporative heating surface of the boiler is 5,370 sq. ft. The superheater has 48 elements and a heating surface of 1,129 sq. ft.

According to Cole's ratios, a superheater locomotive having 29-in. cylinders and operating with 195 lb. boiler pressure produces a maximum cylinder horsepower of 2,954 at a piston speed of about 1,000 ft. per minute. On the assumption that each horsepower requires 20.8 lb. of superheated steam per hour, this locomotive working at maximum



Elevation and Sections of the Wabash 2-10-2 Type Locomotive

capacity requires 61,443 lb. of steam per hour. In accordance with the equated values of heating surface used in Cole's ratios, the firebox, combustion chamber and firebox water tubes are rated at 55 lb. of steam per square foot of heating surface per hour. Tubes 2¼ in. in diameter and 23 ft. long with ¾-in. clear spacing will evaporate 8.03 lb., and the flues 5½ in. in diameter, having the same clear spacing, will evaporate 9.18 lb., of steam per square foot of heating surface per hour. Using these values for the various evaporating heating surfaces, the maximum evaporation is estimated at 62,791 lb. of steam per hour, or 102 per cent of the actual maximum requirement.



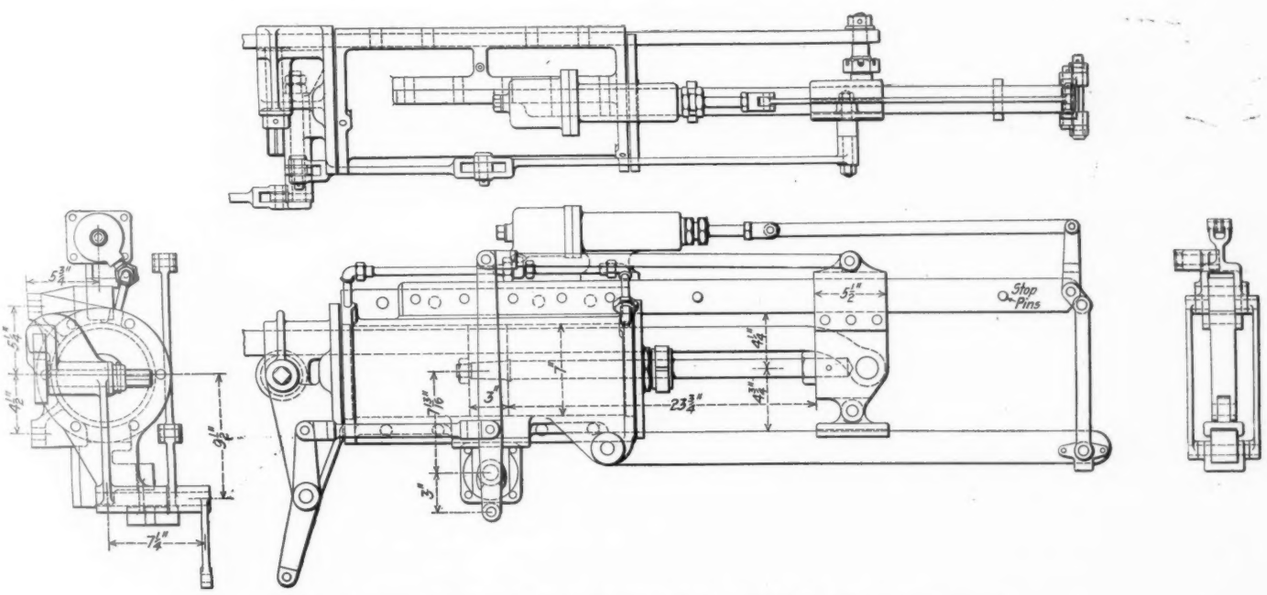
Tube Sheet and Section Through Firebox

The cylinders are of cast iron and both the cylinders and valve chambers are bushed. The back cylinder heads are of cast steel, while the front heads are of cast iron. Steam is distributed by piston valves 14 in. in diameter and controlled by Walschaert valve gear.

The power reverse gear is the latest type of Mellin reverse gear furnished by the American Locomotive Company. This gear is provided with a friction clamp locking device which is actuated by a spring. One of the illustrations shows the gear as it is applied to the Wabash locomotive. The reverse lever connecting rod is attached to the lower end of the rocker arm shown at the left end of the cylinder, while the reach rod is coupled to the crosshead. The gear is operated by means of a rotary valve located below the middle portion of the cylinder, the lapping of the valve is accomplished in the usual manner by a combination lever connected at the upper end with the crosshead of the reverse gear cylinder. At the left end of the cylinder is a rack and pinion device for moving the gear when air pressure is not available.

It will be seen that the crosshead operates on a single bar guide attached to the top of the cylinder. Below the crosshead is a hinged bar connected at the outer end to the fixed guide bar by means of a bell crank and link. The locking of the gear is effected by a spring which, acting through the medium of the bell crank, causes the crosshead to be tightly gripped between the guide bar above and the hinged bar below. The clamping device is so designed that the pressure gripping the crosshead is about eight times the working capacity of the crosshead. When the reverse lever is moved, the clamp is released by means of a small pressure cylinder located in the rear of the spring cage. Through an automatic shifting valve pressure is admitted to this cylinder whenever air is admitted to either end of the operating cylinder. At the completion of the desired motion of the piston in the cylinder, the crosshead is again clamped in position by the release of the air pressure acting against the clamping spring.

The locomotives are fitted with the Woodard engine truck and the Cole trailing truck, under a Commonwealth Steel Company's cradle casting. This casting combines the two rear frame slabs, footplates, trailing truck, spring yoke brackets, and the trailing truck radius bar fulcrum.



The Mellin Power Reverse Gear Used on the Wabash 2-10-2 Type Locomotive

The leading driving axle is fitted with lateral motion driving boxes and the main axle with long main driving

boxes. Among other specialties with which the locomotives are fitted are the Woodard throttle valve, Radial buffers and Foulder solid back end main rods.

The principal data and dimensions are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. Coal
Tractive effort	69,700 lb.
Weight in working order	395,000 lb.
Weight on drivers	314,000 lb.
Weight on leading truck	28,500 lb.
Weight on trailing truck	52,500 lb.
Weight of engine and tender in working order	591,000 lb.
Wheel base, rigid	16 ft. 9 in.
Wheel base, driving	22 ft. 10 in.
Wheel base, total	42 ft. 4 in.
Wheel base, engine and tender	78 ft. 4¼ in.

Ratios

Weight on drivers ÷ tractive effort	4.5
Total weight ÷ tractive effort	5.7
Tractive effort × diam. drivers ÷ equivalent heating surface*	648.1
Equivalent heating surface* ÷ grate area	85.3
Firebox heating surface ÷ equivalent heating surface,* per cent	5.5
Weight on drivers ÷ equivalent heating surface*	45.6
Total weight ÷ equivalent heating surface*	57.4
Volume both cylinders	24.5 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	281.4
Grate area ÷ vol. cylinders	3.3

Cylinders

Kind	Simple
Diameter and stroke	29 in. by 32 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	7 in.

Wheels

Driving, diameter over tires	64 in.
Driving, thickness of tires	4 in.
Driving journals, main, diameter and length	12 in. by 20 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6 in. by 12 in.
Trailing truck wheels, diameter	44 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	E. W. T.
Working pressure	195 lb. per sq. in.
Outside diameter of first ring	87 9/16 in.
Firebox, length and width	120½ in. by 96¼ in.
Firebox plates, thickness	Crown, sides and back, ⅜ in.; tube, ⅝ in.
Firebox, water space	6 in.
Tubes, number and outside diameter	253—2¼ in.
Flues, number and outside diameter	48—5½ in.
Tubes and flues, length	23 ft.
Heating surface, tubes and flues	4,991 sq. ft.
Heating surface, firebox and arch tubes	379 sq. ft.
Heating surface, total	5,370 sq. ft.
Superheater heating surface	1,129 sq. ft.
Equivalent heating surface*	6,883 sq. ft.
Grate area	80.2 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	196,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	18 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CONSERVATION OF RAILWAY MATERIAL*

Possibilities for Getting More Service from Used Material and Using New Material Without Waste

BY M. K. BARNUM

Assistant to Vice-President, Baltimore & Ohio, Baltimore, Md.

"CONSERVATION OF MATERIAL" is a broader term than reclamation, the one frequently used, and, therefore, I think preferable. The reclamation of material has commonly been limited to the sorting of old material, particularly scrap, and picking out such parts as could be repaired and restored to service. Conservation goes much further than that because it is defined as "the preservation of natural resources for economical use." The saving and economical use of material, in any manner, may be considered as the conservation of material. Most of the suggestions I will offer pertain to the collecting and sorting of material which is either serviceable or can be repaired for service, and some other items that may properly be considered in this connection.

The present prices of most material that the railroads use are from twice to four times what they were two or three years ago, and the value of scrap has increased somewhat in proportion, so that it is more profitable now to work over old material than it was then.

The first and most important thing is to collect the old material, and it is surprising to see how the small bits of iron and steel, such as rivet heads, nuts, washers, etc., that are a by-product of repairing cars, count up when gathered together in a pile. The best way to show the value of this small scrap that, ordinarily, is thought to be worthless, is to pick it up and keep an account of the labor and weight of material collected, and the result will be very convincing. As an example—not long ago at one of our steel car repair tracks boys were employed to gather rivets and rivet heads and in four or five weeks collected about 40 tons, worth over $1,300 at a cost of about $100 for labor. At another yard men were unloading yard cleanings into a swamp to release the cars and to fill the swamp. It was noticed that in this stuff there were some small bits of iron, which the men were instructed to throw into a box, and in a month they had saved about 30 tons of scrap worth, approximately, $1,000.

The scrapping of old cars leaves many truss rods, arch bars and other kinds of iron and soft steel, which can be worked over into new forgings, and our road has a rolling mill in which such pieces are worked down into bar iron for grab irons, safety appliances, etc. This mill, which cost approximately $10,000 installed, produced a net profit, in the first six months of this year, of over $40,000. Some roads have questioned the advisability of installing such a plant, but I see no reason why any railroad which has a considerable amount of rolling stock cannot profitably use a re-rolling mill.

In gathering up and sorting scrap iron from cars and locomotives and track work it is always found that a considerable amount of good material is brought in, which should be carefully culled out, as much of it can be returned to service with slight repairs. Brake shoes which are good for more mileage are often found in the scrap, having been taken off because they would not make the long runs, and these brake shoes are sorted out and applied to cabooses, cars and locomotive tenders that are on short runs.

It is hardly necessary to quote in detail the increases in prices of locomotives and cars, but I have some figures here which show that in the two years between May, 1915, and May, 1917, there was an average increase of 50 per cent in the cost of steel passenger cars, 75 per cent in locomotives and 75 to 100 per cent in freight cars.

It was formerly the practice of many roads, when their freight cars had reached the limit of their profitable life, to burn them so as to get the scrap iron out in the easiest way, but it has been found that burning iron reduces its value approximately 10 per cent as scrap, and the wood is de-

*From a paper read before the New York Railway Club.

stroyed. Tests which we have made show that the cost of dismantling a freight car is from $5 to $10 and saving the wood in condition for further use, results in a net profit of from $10 to $20 per car, according to the design. Our road has built many platforms, fences, storage bins, etc., and by using such second hand material we make a perfectly good job at small cost.

Many roads have reclamation plants, and I think they are all working profitably. The more common practices of cutting bolts to shorter lengths, rethreading them, repairing brake beams and sorting out the usable material, such as nuts, washers, etc., are followed on nearly all roads. The road with which I am associated has three such plants, the largest being at Zanesville, O., where we handle anything that is worth working over and fit it for service. There is a tin shop where we repair oil cans, lamps and tinware of all kinds. We have a shop where signals which have been replaced with new or larger sets are thoroughly overhauled, tested and prepared for installation at less important points. There is a saw-mill at which second-hand bridge timbers and various kinds of pile butts, etc., mostly coming from the maintenance of way department, are worked over into usable sizes, and they are prepared to fill orders for a large variety of finished material for buildings, car braces, car siding, roofing, etc. Some of the pieces are large enough to make good track ties, while the small pieces can be used for repairing hand cars, push cars, etc. Most of that material is practically worthless until it is resawed, after which it is worth from $20 to $60 per thousand feet. At the same shop we save the scrap pieces of wood and reduce them into charcoal for dining cars and shops, effecting a saving of about $90 a month.

Our road has a large number of locomotives equipped with stokers, which have proved so satisfactory that they are used on all new freight locomotives. After four or five years of service some parts wear out, and we have fitted out one shop for the reclamation of stoker material, where we can do almost any kind of work up to building a stoker complete.

The electric and gas welding processes have revolutionized a large amount of shop work which was formerly done by forging, riveting or in other ways, and I believe that there has been no one process introduced in the last ten years that has been of greater help to the railroads. The collars of worn car axles and sharp flanges on locomotive tires can be built up successfully; the latter operation is often done under the engine, thereby saving the cost of removing the wheels or tires. The building up of flat spots on tires and car wheels and of worn coupler locks and knuckles enables them to be retained in service, and a great variety of castings which break can be welded and made practically as good as new. One of the biggest savings that has been effected is by the welding of broken cylinders. One of our master mechanics told me, recently, that a saving of about $4,000 had been made in one month by the welding of broken cylinders. The welding of firebox sheets, both for repairs and new work, is being done successfully, and in some railroad shops the entire firebox is welded up without the use of rivets except in the mudring.

Much track material is sent in as scrap which in the past had not been thought worth working over, but we have found that it pays to reclaim track spikes, nuts, washers, track bolts and anti-creepers, and much can be saved by building up worn switch points and frogs by the welding process.

The use of old ties has been studied by most railroads, and, in every case I believe, the conclusion has been that it does not pay to pick them up, bring them in to terminals and cut them up for firewood or similar purposes, because the expense of collecting and preparing them for use makes them cost as much, or more, than new wood. So the usual practice is to pile up old ties alongside the track and burn them.

Some of the larger roads have timber treating plants and there are several commercial plants which treat ties and timber. The fact that this treatment costs only about 25 cents a tie and doubles the life of the tie makes it an excellent proposition. The average railroad tie, in the middle and eastern United States, has a life of about 7 years, not treated, and, when treated, it runs to 14 years or more, the first price of the tie being the same in either case. In using treated ties it is customary to apply steel tie plates under the rails, to prevent the ties from being cut and spoiled by mechanical wear before they rot out.

One other very profitable department of reclamation work is the saving and repairing of grain doors. Some roads have a large grain business, and they have found that grain doors can be repaired for about 10 cents a piece, whereas, a new door will cost not less than 75 cents. The repairing of grain doors leaves a considerable amount of small pieces, which can be cut up and used for dunnage and powder strips, and also for making boxes for shipping nuts, bolts, etc.

The collection and baling of old paper for sale has recently been quite profitable, although for a time it was not worth while. One station on our road sold $128 worth of old paper after a house clearing, and another sold $700 worth within a year. Those are some of the larger stations, but they show the desirability of saving all old papers for sale.

Another item which has not received much attention in the past, because it was not thought worth while, is the saving of coal and coke which becomes scattered along the tracks in switching yards. When coal could be bought for $1 a ton at the mines, coal thus reclaimed hardly repaid the cost of picking it up, but at the present high prices it is worth saving.

I have said that the most important thing is to collect the old material so that it can be sorted out and the good separated from that which is only scrap. As an inducement to the section men to pick up material along the tracks, one of our superintendents has offered prizes to the section foremen who pick up the largest number of one inch nuts, and, on another occasion, the largest number of oil cup caps. The result was surprising and gratifying. One foreman turned in about 300 and another one about 200 nuts, most of them as good as new.

Many railroads are using box cars with either inside or outside metal roofing, and when they reach their limit of life much of the roofing is fit for further service. It can be used for making stove pipe, pails, cans, for roofing buildings and for many other purposes.

Some of the secondary results of the conservation of material and the cleaning up of scrap are the improved appearance of the property, the greater orderliness and a stimulated interest on the part of the men in taking care of material.

Our company has studied the wastes in dining cars, and a great deal has been accomplished in reducing them. The prices of all supplies have gone up, but, by following the advice of the Federal Food Commission, the prices of meals have been kept down pretty nearly to what they were heretofore, while the quality has been kept up, and, at the same time, a considerable saving has resulted.

The use of stationery and office supplies has been watched, with some care on most roads, but the amount of it is so great on the average road that it is worthy of closer attention. We have one man who gives his entire attention to the study of requisitions and the inspection of stock on hand at various offices, with very profitable results.

Some reclamation operations that have been tried are of rather doubtful value, and it is a question whether they pay. Among these are the re-making of brooms, renovating caboose cushions and camp mattresses, retapping nuts and

tinning lanterns. The question of painting brake beams and springs, after they have been repaired, is open to discussion but I believe it pays.

Another important item of conservation, which is worthy of more attention, is the protection of material from the weather, especially near the seacoast, where there is a good deal of wet and stormy weather. All finished work, such as threads of bolts, nuts and pipe, should be protected from dampness, or they will soon become rusted beyond any possible use. The same is true of steel plates and many of the finished parts for locomotives; dressed lumber for car work ought to be protected from rain, snow and sun. The ordinary rough castings stand exposure for several years, but if small they will be seriously damaged in a few months.

As an example of the value of scrap, I have obtained the figures for a large road, which show that in 1916 over $3,000,000 worth of scrap was sold and for the first six months of 1917 over $2,000,000 worth.

The motto which the railroads have adopted to guide them in their work is "What can we do to help win the war?" and this test should be applied to every problem that arises, because that is the biggest question now before us. Therefore, the conservation of material is more important now than ever before and it is one of the things that will be most helpful in winning the war.

DISCUSSION

E. J. McVeigh, general storekeeper, Grand Trunk System: Material is money, first, last and all the time. Unfortunately the railways have not learned that simple fact. They have never taught their employees to think of material as money. Due to the peculiar nature of railway operation, costly material is placed in the hands of many men totally untrained in the handling and value of the material. How many trainmen have been told that a journal bearing costs $6 when new and is worth $4.80 after it has served its purpose, if it is returned to the stores department; that a steam hose is worth $4.80 new and $3.80 after it has been worn out?

The railway "material man" buys, receives, cares for and delivers new material, but in addition to this he should educate the men handling the material as to its value, both new and old. When the material has fulfilled its function it once more becomes material and the material man does not let go of it until he knows that it has been conserved. The material man should have the proper facilities and organization for doing this. The old method of selling all used material as scrap has made the scrap dealers rich. Those roads which have developed central scrap and salvage yards have found that it pays. Average figures show a net increase of $4.85 per ton in the price received for scrap that is examined for usable material and sorted. In addition to this the reclaimed material is of great value to the car repair and shop men. It keeps them well supplied with material.

Neglecting the material for the convenience of the repair forces we have the $4.85 net gain where a railroad handles its own scrap. A railroad will "make" three tons of miscellaneous scrap per year per mile of road operated. Thus a road of 4,000 miles will be able to save $58,200 per year by handling its own scrap. In brass there is still a larger amount to be saved. The salvage in all hose is very large. What other department of a railroad on so small an investment can show so great a return?

W. F. Jones, general storekeeper, New York Central: If the materials throughout the world wasted today were saved and applied to proper uses, we would be confronted with an economic revolution tomorrow. When a man's hands are full, it is natural for him to be extravagant. It is born in him and nature has placed before him almost unlimited resources to be obtained at the expense of but little endeavor.

To change this inherent characteristic has been the lifework of many men who have had the foresight to realize that, with our ever increasing population, the time will come when we will be confronted with a fight for existence.

In managing a business where men are employed, waste and extravagance will reduce the profits unless a watchful eye is placed on every detail of operation. This is not so difficult in a manufacturing plant where each individual workman is under the direct personal supervision of his foreman. Different conditions prevail in operating a railroad. While a large number of men are employed in buildings, under direct supervision, there is a vast army under indirect supervision, in the yards, along the road and on the water.

Conservation should begin with the quality of the material. It is not a paying proposition to use inferior material in a job that requires the best material that can be manufactured. A pair of wheels for a car may cost $25.00 and the scrap value may be relatively high. The expense of that pair of wheels is not in the material, but in the delay to the car and contents, cost of switching, and labor of handling and of application and removal. If the life of a pair of wheels can be increased a year by using better material, even at higher price, would we not be conserving material?

Le Roy Cooley, general storekeeper, Central of New Jersey: Reclamation is so closely interwoven with conservation that I consider the two go hand in hand. If you can make the old material last a little longer or perform a further function you are conserving the new.

We have no elaborate scrap docks equipped with expensive machinery; we handle our reclamation work through our main locomotive and car shops, but not always with skilled labor, unless the class of work so demands. I will mention a few of the practices which we employ that might be of interest. No doubt all present have observed how the siding of box cars first becomes decayed at the sills and eaves, requiring renewal while the center portion is practically as good as new. Our practice is to cut off the decayed ends and use the siding as roofing.

A year or so ago all roads were obliged to re-build in a degree practically all of their equipment to meet the demands of the Interstate Commerce Commission, necessitating the removal of grab irons, brake wheels, brake staffs, cutting levers, etc. The old grab irons were used for the construction of bolts, as were also the brake staffs and cutting levers. The brake wheels which we were obliged to remove did not have sufficiently large brake staff fit to meet the requirements. We were able to reclaim practically all of these wheels by heating them and forcing the hole larger with a punch of proper size, with but little expense and little loss through breakage.

We have a rattler through which we pass all old or rusty nuts and washers. They are then sorted and those requiring re-threading are given such attention.

We found some time ago that it was possible in a large degree to reclaim our cast steel journal boxes through the electric welding process, by building them up in places where worn. This is also being done with front end coupler pockets, many of which require renewal on account of the pin holes becoming elongated. Our practice is to true up the hole by the electric welding process and return the pocket to service. Electric welding of bolsters and side frames is no doubt a common practice and the saving is enormous.

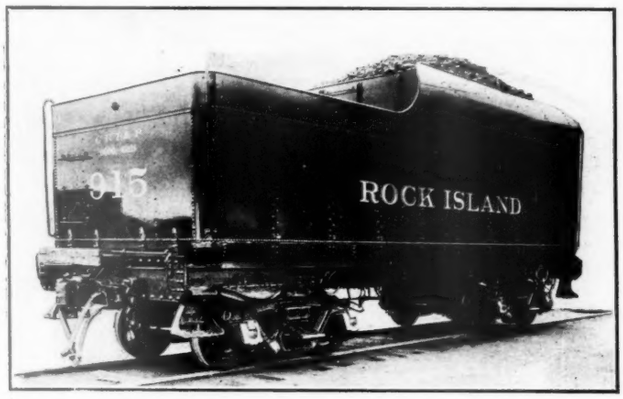
R. V. Wright of the *Railway Mechanical Engineer* called attention to the moral effect the reclamation of material has on the men. Before the war there was plenty of material and at the prices that prevailed at that time it was not economical to reclaim material to the extent that it is at the present time. The fact that material is scarce and that the cost has risen materially should be impressed upon the men so that this matter will be given the proper attention. In addition to the material the conservation of labor is a very important problem and should be given consideration.

An Innovation in Tender Design

Rock Island Lines Are Using Construction Which Eliminates Angle Iron at Bottom Edge of Tank

A TENDER which includes some unusual features has been designed by W. J. Tollerton, general mechanical superintendent of the Rock Island Lines, and is now being used on that road. The principal feature of the design is the method of construction adopted for the bottom of the tender tank which it is thought will result in considerable economy in maintenance.

The tender is of the rectangular type with a capacity of



Rock Island Tender with Unusual Method of Joining Vertical and Bottom Tank Sheets

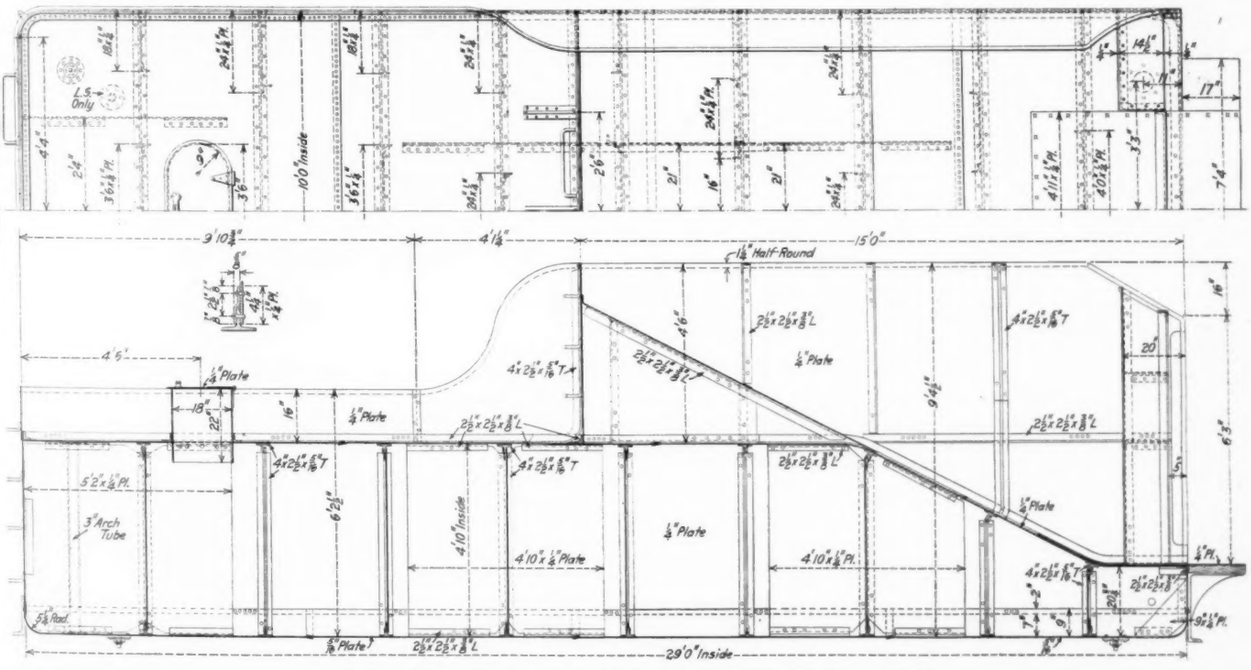
9,000 gal. of water and 16 tons of coal. It is 29 ft. long, 10 ft. wide, and the maximum height from the bottom sheet to the top of the coal space is 9 ft. 4½ in. The water space is 4 ft. 10 in. high at the back for a distance of 20 ft. 4 in., sloping from that point to a depth of 20¾ in., which is reached two feet from the front.

The bottom sheet of the tank, instead of being joined to the side sheet by angles, has the edges flanged upward on all four sides with a radius of 5¼ in., and is riveted directly to the vertical sheets. The side sheets of the tank are rounded in the usual manner at the corners where they are riveted to the end sheets. At the four lower corners steel castings are used to join the curved surfaces of the bottom and side sheets, thus obviating a difficult job of flanging. It is intended to have the bottom sheet of the tank in one piece, but it has been impossible to secure plates large enough for this purpose under the present conditions.

The construction used on the lower seams eliminates one row of rivets for the entire distance around the tank, does away with the corner seam, which often leaks and is difficult to caulk, and brings the single remaining seam several inches above the bottom of the tank. The intermediate seams in the bottom and side sheets are made with the usual single riveted lap joint. The bottom sheet is 5/16 in. thick, while all others are ¼ in. thick.

The sheets in the water space are braced by T-irons, which extend in one piece down one side, across the bottom and up the opposite side. These braces are spaced three feet apart and are bent at the lower corners to fit the curve of the sheet. By making the T-irons continuous across the three surfaces the plate is stiffened to such an extent that it is thought the vibration of the sheets, which often causes them to crack near the lower edge, will be entirely eliminated. Gusset sheets are also used to reinforce the lower edges, both at the sides and at the front.

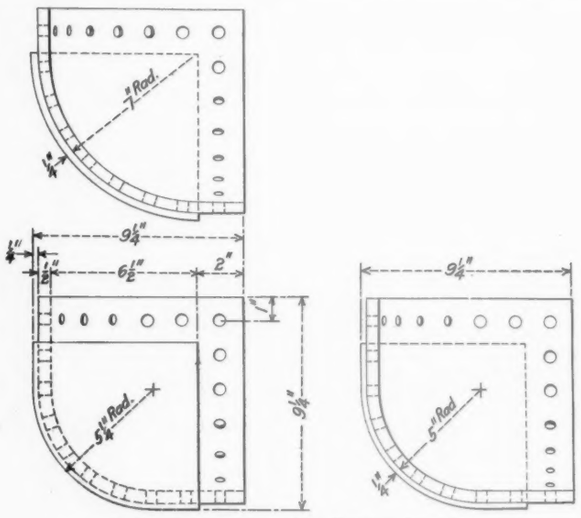
The upper sheet of the water space is joined to the side and end sheets with angle irons in the usual manner. Splash plates are placed crosswise and lengthwise in the tank and are fastened to the T-irons and to angle irons. At the points where the splash plates are riveted they are reinforced with



Rock Island Lines Tender Tank with Flanged Bottom Sheets

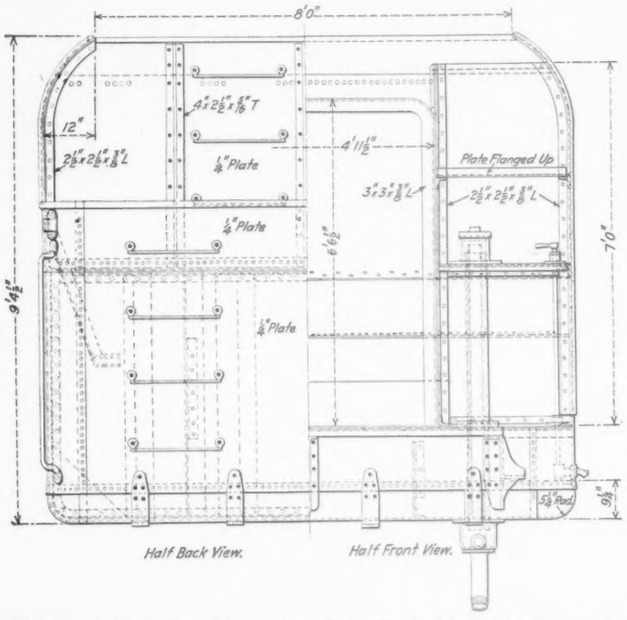
a lap plate which is shown in detail in one of the illustrations.

The coal space is 15 ft. long and 7 ft. 7 in. deep at the front, sloping uniformly from a point 2 ft. from the front of the tank. The sides are curved inward at the top to prevent the loss of coal. This construction, which originated on the Chicago, Burlington & Quincy, is now standard on the Rock Island. The curve at the top is formed by rolling the sheets,



Cast Steel Corner for Tender Tanks

which are braced by angles and by one T-iron on each side extending diagonally from a point about half way down the side sheet to the slope sheet. A 1¼-in. half-round bead is used at the upper edges of the sheets. The rear portion of the slope sheet, which is raised above the water space, is stiffened by angle irons and supported at the end by T-irons



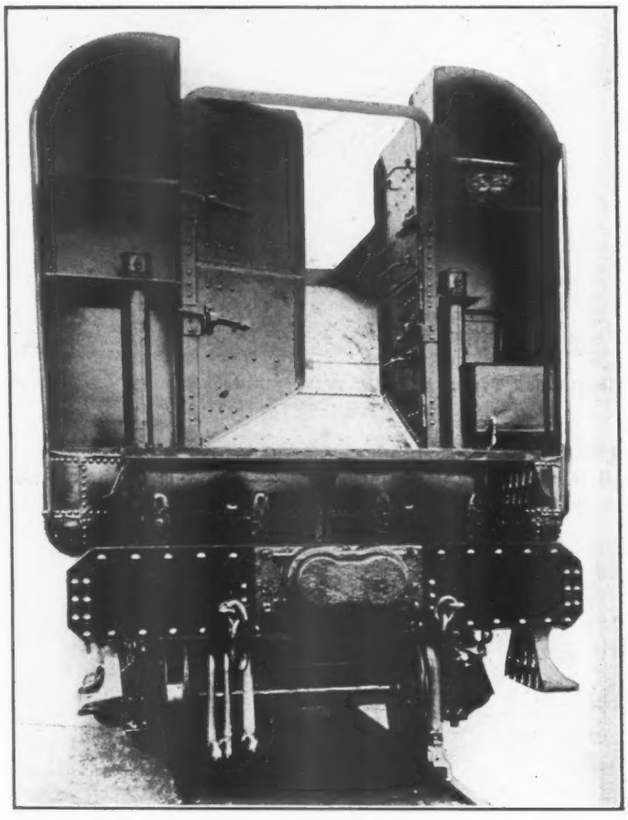
Front and Back End Elevations of the Rock Island Tender Tank

resting on the top of the water space. The upper and lower halves of the coal gates are made separate, as it has been found that opening the upper section of the coal gates materially improves the ventilation in the cab.

At the front corners of the tank there are two cupboards entirely open at the front, which provide an unusually handy place for tools and clothes. By carrying the cupboards up slightly higher than the coal gates a much greater amount of space than is found in cupboards of the ordinary type has been provided without decreasing the coal space on the tender. The upper compartments are designed especially to furnish a convenient place for the enginemen to carry their clothes boxes. In the lower compartment is a steel box in which ice is placed for the purpose of cooling the drinking water, which is carried in jugs. The Lindstrom syphon extends up inside the cupboard and is supported by one of the shelves. The details of the arrangement of this device are illustrated.

The tender frame with which this tank is used is 8 ft. 2 in. wide over the side sills, and 9 ft. 2 in. wide over the end sills. The tank rests on 2-in. deck boards spaced about 2 ft. 9 in. apart and is anchored at the ends by the usual fastenings.

This type of tender has been in use in through-passenger



The Open Cupboards on the Rock Island Tender Are Exceptionally Roomy

service for three months and reports indicate that it has very good riding qualities. Tenders of similar construction will also be used with 30 freight locomotives now on order for the Rock Island. Application has been made for patents to cover the principal features of the design.

Chemical Heater for Soldiers.—*The Tech* of Boston tells of an individual heating apparatus for soldiers which Colonel Robert L. Howze is now testing to determine its practicability. The heater is not larger than a canteen and it is claimed that it will keep hot for 36 hours and then be recharged for another period. The heater is filled with a chemical fluid which is first heated by immersion in boiling water. The chemical action increases the heat to a high degree and maintains it for 36 hours. A new charge is a chemical substance no larger than a pea. The "stove" and fuel may thus be carried by a soldier in his haversack.

RAILWAY POWER HOUSE ECONOMICS

Construction and Operating Costs of the Average Power Plant Serving a Railroad Repair Shop

BY V. T. KROPIDLOWSKI

III

THE two preceding articles of this series have dealt with the general phases of shop electrification and the factors entering into the cost of power. The present article is devoted to the discussion of a concrete example, the cost of construction and operation of the shop power plant being analyzed and a comparison made with the cost of power purchased from a public service plant.

A repair shop of a capacity capable of turning out an average of 30 locomotives and 175 cars per month will be considered. The buildings in such a plant will have a cubical content of about 4,826,746 cu. ft. Providing one square foot of radiating surface for each 150 cu. ft. of building volume for heating this building, which is considered sufficient to meet shop requirements in severe winter weather, a plant of this magnitude will require 32,178 sq. ft. of radiating surface. One square foot of radiating surface will condense approximately 0.4 lb. of steam per hour and the maximum heating requirement of the plant will therefore require 32,178 x .4, or 12,871 lb. of steam per hour. The boiler capacity necessary to meet this maximum requirement, allowing an actual evaporation of 30 lb. of water per hour per boiler horsepower, is 429 hp.

TABLE I—MINIMUM REQUIREMENTS FOR BOILER CAPACITY IN THE SHOP PLANT

Power consumer	Capacity	Maximum developed hp.	Average hp.	Boiler hp.
Air compressor	2,000 cu. ft.	300	185	200
High pressure pump	300 gal.	15	4.5	20
Roundhouse blower line	.....	..	..	100
Steam hammer	1,500 lb.	37	5	30
Steam hammer	1,100 lb.	27	3	20
Heating service	32,000 H.S.	..	429	230
Total	.....	..	..	600

Here is the need of an investment at the outset, which must be made irrespective of how the motive power for the shop machinery is obtained; and this does not represent the complete investment, there being other steam requirements which bring up the total minimum shop boiler capacity to 600 boiler horsepower, as shown in Table I.

In Table II is presented an estimate of the cost of purchasing, installing and housing this equipment. The total amount of the investment thus required is $43,251. With an investment of this magnitude unavoidable, the question immediately rises whether the additional investment required to extend the power plant facilities to meet the complete power demands of the shop will not make possible a lower rate for power than can be obtained if power is purchased from a public service plant.

An analysis in detail of the power required for machine tool equipment in a shop of the capacity herein submitted is given in Table III. The total horsepower requirement of the shop tools and machinery is 570 hp. Adding to this the power required for the service pump, the coal chute hoist and locomotive hoist, which may be electrically driven to equal advantage in either case, and the electric lighting and welding loads, the total electrically driven load is 660 hp. As shown in Table IV, a rather high diversity factor of 65 per cent has been selected. On this assumption the maximum demand which may be expected is 429 hp., or 320 kw. We may therefore install with safety electrical equipment having a capacity of 350 kw. In Table V is shown in detail an estimate of the additional investment for power plant equipment to meet these requirements.

In a previous article* it has been shown that when a given boiler capacity is required to provide steam for shop heating, the power generated as a by-product of the heating system by passing the steam through a prime mover, will create only about 10 per cent additional demand on the boilers. In considering the minimum demand on the shop boiler plant when electric power for driving the machine tool equipment, lighting, etc., is to be purchased outside, the additional boiler capacity required to make up the deficit in steam for heating, after using the exhaust steam available, was found on this basis to be about 230 boiler horsepower. In the same way in Table V, where the additional equipment necessary to provide a complete shop power plant is considered, this boiler capacity provided primarily for heating service, is available for the production of power and but 200 additional boiler hp. is required.

TABLE II—INITIAL INVESTMENT IN POWER HOUSE WHERE POWER IS PURCHASED FROM AN OUTSIDE SOURCE

Buildings and Equipment	Quantity	Unit Used	Unit Cost	Cost per hp.	Cost per kw.	Total Cost
Station building, bare building complete, including mill work, foundation, etc., not plumbing, lighting, etc	117,000	cu. ft.	$0.09	...	...	$10,382
Boiler room equipment:						
Boilers, exclusive of setting	600	B-hp.	15.00	$15.00	...	9,000
Boiler settings	600	B-hp.	8.00	8.00	...	4,800
Smoke flues	600	B-hp.	.75	.75	...	450
Chimney, concrete	600	B-hp.	5.00	5.00	...	3,000
Feed pumps	600	B-hp.	.50	.50	...	300
Feedwater heater	600	B-hp.	.80	.80	...	480
All piping and pipe covering	600	B-hp.	8.00	8.00	...	4,800
Coal bin and ash handling facilities	600	B-hp.	1.00	1.00	...	600
Miscellaneous: Painting, instruments, runways, etc	600	B-hp.	.75	.75	...	450
Engine room equipment:						
Air compressor	300	E-hp.	13.00	13.00	...	3,900
Foundation for above, concrete	55	cu. yds.	8.00	1.47	...	440
Service pump 14 in. by 9 in. by 12 in	30,000	gal. per hr.	.014	...	...	420
High pressure pump 12 in. by 7 in. by 12 in	24,000	gal. per hr.	.016	...	...	384
Electrical switch board	350	kw.	2.50	...	$2.50	875
Service equipment: Light, plumbing, tools, cranes, etc	350	kw.	2.00	...	2.00	700
Piping for compressor and pumps	330	E-hp.	4.00	...	...	1,320
General charges: Engineering, purchasing, supervision, etc	350	kw.	4.00	...	4.00	1,400
Total	...		...	...	...	$43,701

THE SHOP POWER PLANT

Fixed Charges.—Into the cost of the power enter the fixed charges upon the investment in the additional equip-

* See *Railway Mechanical Engineer* for July, 1917, page 373.

ment expressly required for the power generation. This investment is shown in Table V to be $28,190. The fixed charges are divided about as follows:

Interest on the investment	5 per cent
Depreciation	5 per cent
Insurance, obsolescence, etc.	5 per cent
Total	15 per cent

The annual fixed charges are therefore $4,228.50.

There need be no increase in labor cost, as there is not necessarily an increase in the power plant force; in fact in some instances there might even be a reduction. To be conservative, however, it will be assumed that a more skilled engineer will be required and an allowance of $300 per year will be made to cover the higher wages. Lubricants, waste and other supplies will amount to about $300 more per year, making the additional charge for labor and supplies $600 a year.

TABLE III—MACHINE TOOL POWER REQUIREMENTS

Description of Tool	Size	Hp. to Drive
Machine Shop		
Drill press, radial	6-ft.	4
Drill press, universal	6-ft.	4
Drill press, radial	30-in.	1½
Drill press, multiple	4-spindle	7
Drill press, vertical	36-in.	2
Drill press, vertical	42-in.	2
Drill press, sensitive	23-in.	1
Drill press, sensitive	20-in.	1
Drill press, sensitive	16-in.	½
Planer	36-in. by 16-ft.	12
Planer	30-in. by 10-ft.	10
Planer	24-in. by 6-ft.	5
Lathe	40-in.	8
Lathe	30-in.	4
Lathes (two)	28-in.	8
Lathes (two)	24-in.	6
Lathes (four)	20-in.	10½
Lathes (two)	16-in.	3½
Lathe, flather	16-in.	1½
Lathe, turret	2 -in. by 24-in.	1½
Lathe, turret	2¼-in. by 24-in.	1½
Lathe, axle	No. 3	8
Lathe, Le Blond	20-in.	2
Lathe, single head	84-in.	3
Lathe, driving wheel	90-in.	15
Lathe, coach	42-in.	12
Quartering machine	86-in.	3
Boring mill	51-in.	7
Boring mill	36-in.	4
Truck wheel borer	36-in.	5
Slotter	12-in.	4
Slotter	15-in.	6
Bolt cutter, single	1½-in.	1
Bolt cutter, single	2⅜-in.	2
Milling machine	No. 2	1½
Milling machine	No. 3	3
Tool grinder, single	8-in. wheel	½
Drill grinder, single	12-in. wheel	2
Yankee double grinder	14-in. wheel	1
Universal grinder	No. 2	2
Double grinders (four)	2-in. by 14-in. wheels	16
Guide grinder	6-in. by 12-in. wheel	2
Grindstone	48-in.	1
Hydraulic press	300-ton	7½
Hydraulic press	150-ton	5
Hydraulic press	40-ton	2
Shapers (two)	24-in.	4½
Shapers (two)	20-in.	4
Pipe threader	2-in. to 4-in.	2
Pipe threader	4-in. to 8-in.	3
Pipe threader	Up to 1-in.	1
Total connected load		223½ hp.
Boiler Shop		
Punch, 36-in. throat	1¼ in. through 1-in.	7½
Shears, 60-in. throat	1-in. plate	10
Rolls	9-ft.	10
Bolt cutter, 4-spindle	1½-in.	5
Stack riveter, 50 in. through	No. 6	3
Drill press	36-in.	2
Horizontal punch, 12 in. through	1⅛ in. through 1-in.	7½
Total connected load		45 hp.
Blacksmith Shop		
Flue cutters (two)	6-in. discs	2
Flue welder	4-in. flues	5
Grinder, double	2-in. by 16-in. wheels	4
Fan	No. 6	7½
Fan	No. 7	10
Grindstone	48-in.	1
Flue rattler	4-ft. by 21-ft.	5
Total connected load		34½ hp.
Car Shop		
Saw, rip	12-in.	3
Saw, rip, automatic	20-in.	10
Saw, rip	20-in.	5
Saw, automatic cut-off	36-in.	10
Saw, band ⅝-in. blade	No. 5	3
Mortiser	3-in. by 18-in.	10
Planer, single head	24-in.	20
Planer, 4-sided, H.S.	6-in. by 15-in.	60
Planer, pony, single	6-in. by 30-in.	10
Gainer	No. 3	10
Borer, 4-spindle	2¾-in.	6
Borer, 2-spindle	1-in.	2
Grindstone	48-in.	1
Knife grinder, American	No. 7	1½
Shavings exhauster	60-in.	35
Drill press	34-in.	2
Total connected load		188½ hp.
Reclaiming Plant		
Bolt cutter, triple	2-in.	4
Drill press	34-in.	2
Fan	No. 3	3
Punch and shear, double	12-in. throat	5
Nut tapper, 6-spindle	2-in.	3
Trip hammer	100-lb.	5
Bolt header	1½-in.	7½
Total connected load		29½ hp.
Saw Mill		
Carriage saw	40-in.	25
Planer, single pony	24-in.	5
Saw, cut-off	24-in.	3
Saw, rip	14-in.	5
Shingle machine, 1-saw	.....	7½
Saw grinder	.....	1
Hand turning lathe	.....	2
Total connected load		48½ hp.
Total connected load for shop tools and machinery		569½ hp.

Coal.—The coal chargeable to power comprises the coal equivalent of the heat lost between the boilers and the heating system when the heating system is in use; when no heating is required all of the coal burned is chargeable to power. The fuel cost depends upon the efficiency of the boilers and engines, the price of coal and the percentage of the total amount of steam generated which is used in the heating system.

The requirements of a compound non-condensing engine will be about 22 lb. of steam per indicated horsepower hour, or 29 lb. per kw.-hr. To be conservative, let us assume 40 lb. per kw.-hr. when no heating is required and 45 lb. when the engine is exhausting against the back pressure of the heating system. The evaporation of the boiler may be assumed as 8 lb. of water per pound of coal. The price of coal, of course, is a variable quantity and in the case of most railroads, under normal conditions it will range from 75 cents to two dollars per ton. The proportion of the steam generated which is used in the heating system is also variable, but for a purpose of this nature it may be assumed that all of the steam is required during a certain number of months of each year and none of it required during the remaining months. Strictly speaking, at the beginning and end of the heating season there are periods when but a moderate amount of heating is required and only a portion of the exhaust is then used, but it is simpler to determine the equivalent number of months during which all of the steam is required for heating. If during the four winter months all of the exhaust is used and during two months before and after this season it varies from 25 per cent to full capacity, it is then sufficiently accurate to assume that the heating season of eight months is equivalent to six months of maximum heating requirements.

TABLE IV—POWER REQUIREMENTS FOR ELECTRICALLY DRIVEN EQUIPMENT

Connected power load	570 hp.
Service pump, electric driven	13 hp.
Coal chutes, electric motor	10 hp.
Locomotive hoist, electric motor	7 hp.
Electric welding plant	10 hp.
Electric lighting	50 hp.
Total	660 hp.
Peak load, 65 per cent diversity factor	429 hp.
Average load, 50 per cent load factor	214 hp.

Water.—An average price for water may be taken as eight cents per thousand gallons. During the heating season it is safe to assume that all but 20 per cent of the water is returned to the boiler; at other times all the water is lost.

With fixed costs and labor charges known, and the coal and water charges calculated for the conditions outlined

above, the charts shown in the illustrations have been prepared. The following example will serve to explain in detail the method of obtaining these figures.

Assume a heating season equivalent to six months of full load steam heating, when all the exhaust is used. During this period the coal chargeable against power is the equivalent of the heat lost between the boiler and the heating system, which should not be more than 10 per cent, but to be conservative it will be assumed as 20 per cent. The price of coal will be taken as one dollar per ton, which is a fair average of what it normally costs the railroads. The maximum power demand has been determined to be 320 kw. Assuming a load factor of 50 per cent of maximum power demand (45.8 per cent of the generator capacity), which is quite high for a repair shop plant, the average load is 160 kw. The working time per year may be taken as 3,000 hours, which is based on a 10-hour day and excludes Sundays and the principal holidays.

TABLE V—ADDITIONAL INVESTMENT IN POWER PLANT TO CARRY ENTIRE SHOP LOAD

Article	Quantity	Unit Used	Unit Cost	Cost per hp.	Cost per kw.	Total cost
Main generating set:						
Horizontal cross compound engine	450	E-hp.	$18.00	$18.00	$8.00	$8,100
A. C. generator	300	kw.	8.00	...	...	2,400
Auxiliary set:						
Vertical automatic high speed engine	75	E-hp.	16.00	16.00	...	1,200
A. C. generator	50	kw.	10.00	...	10.00	500
Foundations for above	70	cu. yds.	9.00	...	...	630
Piping for above	525	E-hp.	3.00	3.00	...	1,575
Wiring up generators, etc	350	kw.	2.50	...	2.50	875
Additional station space	30,000	cu. ft.	.09	...	...	2,700
Additional boiler room space	25,000	cu. ft.	.09	...	...	2,250
Additional boiler capacity	200	B-hp.	39.80	...	...	7,960
Total	...		...	...	...	$28,190

TABLE VI—AVERAGE FIXED CHARGES, LABOR AND SUPPLIES, CENTS PER KILOWATT-HOUR

Load factor	5	10	15	20	25	30	35	40	45	45.8
Unit cost	9.20	4.60	3.06	2.30	1.83	1.53	1.31	1.15	1.02	1.00

TABLE VII—AVERAGE COAL AND WATER COST, CENTS PER KILOWATT-HOUR

Cost of coal, dollars per ton	Months of exhaust heating 2	4	6	8
$1.00	0.25	0.22	0.18	0.14
2.00	.47	.40	.33	.26
3.00	.69	.59	.49	.38
4.00	.91	.77	.64	.50
5.00	1.12	.96	.79	.62

TABLE VIII—AVERAGE COST OF POWER FOR THE YEAR, CENTS PER KILOWATT-HOUR

Cost of coal, dollars per ton	Months of exhaust heating 2	4	6	8
$1.00	1.25	1.22	1.18	1.14
2.00	1.47	1.40	1.33	1.26
3.00	1.69	1.59	1.49	1.38
4.00	1.91	1.77	1.64	1.50
5.00	2.12	1.96	1.79	1.62

The cost of coal during the six months heating season chargeable to power is:

$$160 \times \frac{3{,}000}{2} \times \frac{45}{8} \times 0.20 \times \frac{\$1}{2{,}000} = \$135.00$$

The portion of the year when there is no exhaust steam heating, and when only part of the exhaust is used for heating, is equivalent to six months of straight non-condensing operation. The cost for coal during this period is therefore,

$$160 \times \frac{3{,}000}{2} \times \frac{40}{8} \times \frac{\$1}{2{,}000} = \$600.00$$

To the coal cost must be added the cost for water, which may be taken as eight cents per thousand gallons. During the heating season, the heating system returns 80 per cent of the boiler feed. The cost for water is then

$$160 \times \frac{3{,}000}{2} \times \frac{45}{8.33} \times 0.20 \times \frac{8 \text{ cents}}{1{,}000} = \$20.75$$

For the other six months the cost for water is

$$160 \times \frac{3{,}000}{2} \times \frac{40}{8.33} \times \frac{8 \text{ cents}}{1{,}000} = \$92.20$$

The total charges for generating power at the rate of 160 kw. for 3,000 hours a year may be summarized as follows:

Fixed charges		$4,228.50
Labor, oil and miscellaneous		600.00
Coal	$135.00	
	500.00	
		735.00
Water	20.75	
	92.20	
		112.95
Total		$5,676.45

During the year 3,000 x 160 = 480,000 kw. hr., are produced, giving a cost per kw. hr. of 1.18 cents.

In the same manner it is found that when the heating season is equivalent to only three months of full load heating and the price of coal two dollars, the cost per kilowatt hour is between 1.4 and 1.5 cents.

The effect of variations in the price of coal and the length of the heating season on the cost of power for the case assumed are shown in Table VIII. The rates for fixed charges only for varying load factors, are given in Table VI, and the cost of coal and water per kw.-hr. in Table VII. In Figs. 1 and 2 the same data has been presented graphically.

CENTRAL STATION COSTS AND RATES

There is hardly a central station that has as low a fixed charge as that of a railroad shop power plant, and it is doubtful whether the central station can compete on the operating costs. The writer has looked through the Wisconsin Railroad Commission's annual reports and finds one of the public utility companies doing business in this section which has outstanding in stocks and bonds the sum of $8,811,027.11, all of which is invested in property and equipment used for power generation. The total installed capacity of this company's equipment is 13,300 kw. Now, if we assume a load factor of 50 per cent, which is considered by central station men as a very good condition, the output is 13,300 x 365 x 24 x 5 = 58,254,000 kw. hr. per year. Making a very conservative allowance of only 12½ per cent as the fixed charge, it amounts annually to $1,101,382.39. This divided by the yearly kw.-hr. output gives a fixed charge rate of 1.9 cents per kw.-hr. This is the fixed charge only and does not include the items of labor and supplies incident to generation and distribution, general expenses, etc., included with fixed charges in the plant under discussion.

Of course, this does not determine the rate at which the central station is selling current. An examination of rate

TABLE IX—EXHAUST STEAM AVAILABLE AND HOW IT IS USED

Steam Use by	P. Hp. average	Steam rate per hp. hour, lb.	Total steam per hour, lb.
Prime mover	215	26	5,590
Air compressor	185	40	7,400
High pressure pump	5	120	600
			13,590
Deduct steam for heating feedwater			2,666
			10,924
Deduct 20 per cent lost in engines			2,185
Available for heating			8,739
Steam required in heating system			8,826

schedules shows the prevalent rates to run about as follows:

DEMAND CHARGE

For first 100 kw. annual demand	$18.00 per kw. year
For next 100 kw. annual demand	14.00 per kw. year
Above 200 kw. annual demand	10.00 per kw. year

ENERGY CHARGE

First 60 hr. use per month per kw	1½ cents per kw. hour
Next 60 hr. use per month per kw	1 cent per kw. hour
Above 120 hr. use per month per kw	¼ cent per kw. hour

Energy charge subject to five per cent. discount for prompt payment.

Applying the schedule to the shop under discussion, the maximum demand will be 320 kw. and the load factor 50 per cent, making the average load 160 kw. The demand

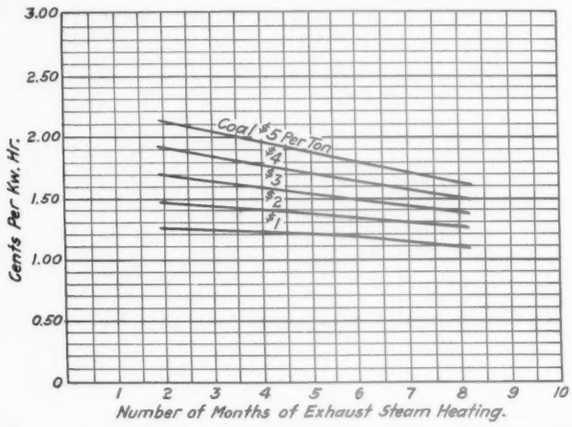


Fig. 1—Average Total Cost of Power in Cents Per Kw. Hr.

cost will amount for the year to $1,800 + $1,400 + $1,500 = $4,700. The energy charge for the year will amount to (60 x 160 x 1½ cents) + (60 x 160 x 1 cent) + (130 x 160 x 0.75 cents) = $396 per month or $4,752 per year. The cost per kw. hour is then 1.97 cents.

Therefore, the difference in rates per kw-hr. in favor of the privately owned power plant is 1.97 — 1.18 = 0.79 cents, or a net saving annually of 0.79 x 480,000 = $3,792.

A question may be raised as to whether all the exhaust steam available in the shop plant will be utilized by the heating system, as has been assumed in this article. The writer has found from an analysis of various plants that the

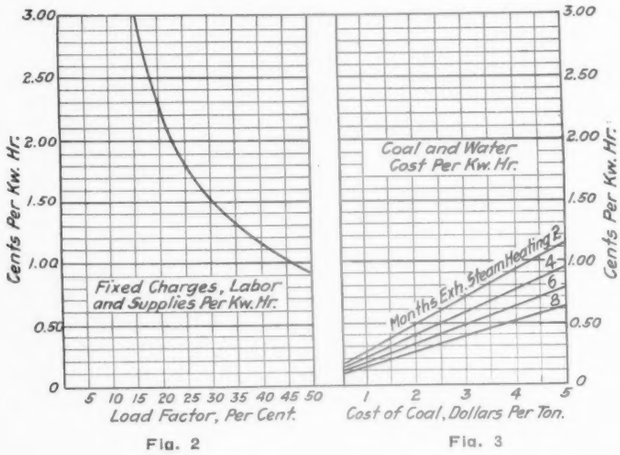


Fig. 2

Fig. 3

power requirements of the average railway shop plant are such as to provide a quantity of exhaust steam which balances very closely with the maximum amount required by the heating system. Table IX shows roughly the distribution of the exhaust steam supply in a plant of the size of that under discussion and an approximate balance is indicated. The steam hammers are not included, as usually the exhaust steam from these units can not conveniently be turned into the heating system.

LOCOMOTIVE DESIGN FROM A MAINTENANCE STANDPOINT*

BY W. H. WINTERROWD
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It is a question if there has ever existed an enginehouse foreman who has not, at some time or other, had the feeling that if some part of a locomotive had been designed a little differently, he could make repairs quicker, easier, and at less expense.

While in many instances he may have been justified in this feeling there are, however, cases influenced by other factors which may have been of greater importance from the standpoint of ultimate economy of operation.

The type and size of a locomotive have an important bearing on certain details of design. A discussion of the factors relating to the selection of the desired type and size is far beyond the scope of this paper as it would involve a thorough consideration of the economics of railway operation. Occasionally some detail of the resulting design, while undesirable from a maintenance standpoint, is unavoidable. However, the majority of locomotive details are free from other than purely local restrictions and may be designed almost entirely from a maintenance standpoint.

It should not be inferred from what follows that mechanical and operating men, as well as locomotive builders, have not given a great deal of consideration to the points mentioned. Very many locomotives in service today bear witness of such consideration. However, there are at present reasons for emphasizing and reviewing the importance of locomotive design from a maintenance standpoint.

Today, under changed conditions, the railroads are being called upon to render greater service than ever before. But little new equipment is available other than that which the railroads may build in their own shops. Repair shops are being worked to capacity. Skilled railway mechanics are scarce. Material of all kinds is difficult to obtain. All of which means that maximum service must be obtained from every bit of existing equipment. It is, therefore, essential to consider every legitimate means whereby the "out of service period" of a locomotive may be decreased and the "in service period" increased.

All new locomotives should be constructed to give maximum service with minimum maintenance. All locomotives being rebuilt, or modernized, should be turned out of the shops prepared to give similar results. Any improvement that can be made to any locomotive, new, modernized, or under repairs, which will result in increased service, increased efficiency, or decreased maintenance, will help to increase the capacity of the railroads.

The following covers briefly a few of the points worthy of consideration:

BOILER

It seems hardly necessary to state that a well designed boiler of ample capacity is easier and cheaper to maintain than one of smaller capacity and which has to be forced continually. The importance of ample capacity can scarcely be overemphasized, either from a maintenance or operating standpoint. Within its limits of weight and size a boiler should be designed to have a capacity as large as possible consistent with other governing factors. In this connection the values of the superheater, the brick arch, and the feed water heater are unquestionable. These values have been practically demonstrated from the standpoint of economy as well as locomotive capacity.

The maintenance of locomotive boilers is an important factor, the greatest difficulties being leaky flues, leaky mud rings, broken staybolts and cracks in firebox sheets.

Knowing that firebox heating surface does a great deal

*From a paper before the Canadian Railway Club.

more work per square foot than flue heating surface, boiler capacity does not depend upon long flues. Short flues are the easiest to maintain.

Many failures are frequently the result of crowding in too many flues, placing them too close to the heel of the flue sheet flange, and the use of too small a bridge. The bead on the flues adjacent to the flanges should always rest on the flat surface of the sheet and never on the curved inside surface of the heel. With 2¼ in., or greater diameter flues, it is best that the width of bridges be not less than ¾ in.

Assuming that these points have been taken into consideration, it is important to see that the shop layerout and driller follow the design. There have been cases where a layerout has located flues incorrectly and also added one or more. It is also important that flue sheet holes be drilled the proper diameter as it is almost impossible to keep flues tight in holes that are too large.

The radii of door and back head sheet flanges should be studied in relation to the staybolt stresses. A moderately large back head sheet radius will reduce the stress in outer rows of bolts by transferring a portion of the load to the wrapper sheet.

Too small a door opening radius will frequently result in cracking of the sheet at this point because of insufficient provision for expansion.

Mud ring corners of ample radius will be easy to construct and maintain. Trouble due to small radius has, in many instances, been overcome by electric or acetylene welding the bottom edges of the sheets at this point to the mud ring.

Flexible staybolts reduce staybolt breakage. A careful investigation will indicate the zones of maximum staybolt stress and sheet movement. In these zones the flexible bolts will give good results and reduce staybolt renewals.

Grates should have sufficient air space, be free as possible from dead spots, and be easy to remove. Where certain kinds of fuel are used, properly designed dump grates may be a means of reducing the time the engine is on the ash pit.

As far as possible, all brackets, clamps, or fittings applied on the boiler or firebox should be so located that staybolts, rivets, or portion of caulking edges will be accessible with a minimum of labor.

In connection with the barrel of the boiler, points which may be mentioned are—throttle and dome arrangement which will permit interior inspection of the boiler without the removal of the standpipe; also the elimination, as far as possible, of all small studs. The latter will apply equally to all parts of the boiler under pressure.

Expansion slides, instead of an expansion sheet, under the front of the mud ring, will eliminate the maintenance of a considerable number of bolts and rivets. Proper consideration of all other expansion sheets will further reduce maintenance of many bolts and rivets and tend to eliminate the many resulting troubles as well.

FRAMES

Frames should be of ample cross section and well braced to hold them rigid. Maximum cross section may be of little avail unless accompanied by sufficient and properly located bracing. In this connection, it hardly seems necessary to mention the advantages of a valve gear located outside the frames. The outside gear has made possible better frame bracing, to say nothing of the advantages of easier inspection and maintenance of the gear itself.

As far as possible, bolt holes in frames should not be located where stresses are greatest.

Where cylinder design will permit, a one piece frame with a top tie splice seems desirable. Where large cylinders prevent the above arrangement, a one-piece frame with ample depth under the cylinders, and having no reduction in thickness, will give excellent service.

MOTION WORK

All bearing pressures should be as low as consistent with good practice in order to reduce wear and resultant replacement. Ample pin length is desirable in order to obtain lateral stability. Arrangement of motion work and design of back steam chest and back cylinder covers should be such that both valve stem and piston rod packing will be easily accessible.

Where possible a piston rod of sufficient length to permit piston ring renewals without the removal of the rod from the cross head will reduce maintenance cost.

Rod bolts and wedges may be dispensed with by the use of solid bushes. Rods should be designed and arranged so that they may be removed with a minimum of labor.

Valves of light weight will reduce the load on all valve parts and result in reduced maintenance.

Selection of high grade, close grained, cast iron for cylinder and valve bushings, piston heads and rings, and in some cases rod bushes, is more than warranted in view of the increased mileage obtainable and the corresponding decrease in maintenance.

If conditions permit the consideration of heat treated, or alloy steels, unbalanced forces may be very materially reduced by the use of light reciprocating parts. The reduction of such forces will in turn tend to reduce the maintenance of pins, bushings, etc.

EQUALIZATION

Locomotives should be equalized so as to secure the most efficient guiding power from both leading and trailer trucks, or wheels. This involves the proper distribution of weight and a means of keeping the proper weights on the various axles at all times.

In general, the best results seem to be obtained by dividing the equalizing system so that the division between the front and back systems is as directly under the center of gravity of the locomotive as the wheel base and other conditions will permit.

The spring gear and equalizing system should receive particular attention when being erected and also when being repaired. The tops of the driving boxes should be milled out squarely and in a plane parallel with the journal bearings. The equalizer and saddles should be fitted to their seats squarely with the pin holes so that the engine will ride squarely on her springs and track properly. The same will apply to the trailer truck equalizers and spring rigging. Trailer trucks that do not carry the back of the engine level are responsible for much avoidable tire wear.

SPRING AND BRAKE RIGGING

A driver brake main fulcrum shaft in two pieces of equal length, the outer ends supported in bushed bearings integral with the main frames and the central portion supported by a sleeve, will give more even distribution of braking power and maximum accessibility for repairs and adjustments.

Brake cylinders, if at all possible, should be located vertically, to reduce packing wear and provide accessibility.

Brake shoe heads and hangers should be so constructed and hung that shoes will swing clear of the wheels when pressure is released and permit easy renewal of shoes.

The ratio of brake cylinder to brake shoe pressure should be kept as low as consistent, and should not exceed commonly accepted ratios. This will insure that false travel will be kept to a minimum.

PIPING

The importance of ample clamping and provision for expansion cannot be overemphasized. Piping should be as short as possible consistent with conditions. Accessibility is

of prime importance. Piping should be so located that there is no obstruction of washout plugs, arch tube covers, pads, etc. Where pipes pass through the front of the cab, provision should be made for clearance or for sleeve protection to prevent wearing or cutting.

The Canadian Pacific has found it a decided maintenance economy to place lubricator piping from cab to cylinders, etc., in a slightly larger wrought iron pipe where the feeds pass beneath the jacket and lagging. By this means the feed pipes can be removed or applied without the necessity of removing any outside covering.

MISCELLANEOUS

Removable liners on engine and tender truck pedestals makes it easy to take up wear and reduce pedestal renewals. To prevent rapid wear between the wheel hub liner face and the driving box sufficient provision for lubrication should be made.

Pilots made of scrap boiler flues cost less to maintain than those made of wood.

All oiling points should be made as accessible as possible. Handholds or small steps, properly located, to make some oiling points accessible, will soon pay for themselves.

Lubricator chokes should be placed in proper position and located as near to the cylinder, or steam chest, as possible. Proper inspection and maintenance of chokes has been found the key to many lubrication troubles.

Boiler jacketing should be applied in sections so that panels can be removed with a minimum of labor.

The foregoing are but a few of the multitudinous details which merit most careful thought. But little mention has been made of the possibilities of simplified design by the use of cast steel. It is felt that with the development of the cast steel industry and the production of castings which are practically equivalent to wrought iron locomotive construction in the future may be greatly simplified. We are today using castings that ten years ago would have been deemed impossible to successfully cast. For example, one piece locomotive frames are now under consideration and will soon be in experimental service. These consist of the two main frames and all cross braces cast in one piece. This is an indication of the degree of simplification that may be obtained. The maintenance of such parts has in turn been made possible by the development of the art of electric and acetylene welding.

Good and far reaching results can be obtained by inviting criticism and suggestions from those directly responsible for construction and maintenance.

In conclusion, simplicity co-related with efficiency should be one of the keynotes of locomotive design. This principle, which, in other words, is simply good judgment, will make for that degree of efficiency which will be reflected, not only in reduced maintenance costs, but also in the increased capacity of the locomotive plant as a whole.

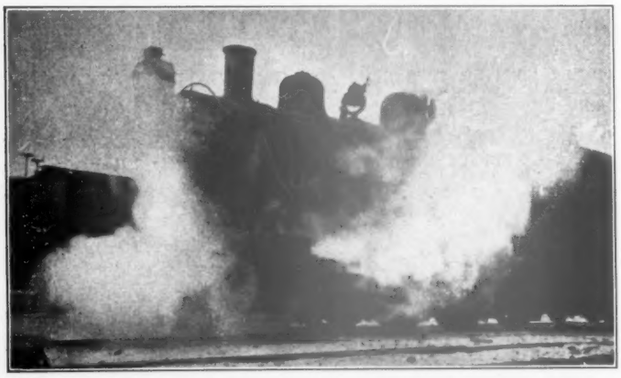
FEDERAL LOCOMOTIVE INSPECTION

Abstract of the Sixth Annual Report of the Chief Inspector of Locomotive Boilers to the I. C. C.

THE tables given herein show in concrete form the number of locomotives inspected, the number and percentage found defective, and the number ordered out of service on account of not meeting the requirements of the law.

They also show the total number of accidents due to failure from any cause of locomotives or tenders and all parts and appurtenances thereof, and the number of persons killed or injured thereby.

The amendment to the locomotive boiler inspection law



A Locomotive Held Out of Service on Account of Steam Leaks

did not become effective until September 4, 1915; therefore, the record for 1916 includes accidents and casualties investigated under the amended law for 9 months and 26 days only.

The following table shows the total number of persons killed and injured by failure of locomotives or tenders, or any part or appurtenance thereof, during the year ended June 30, 1917, classified according to occupations:

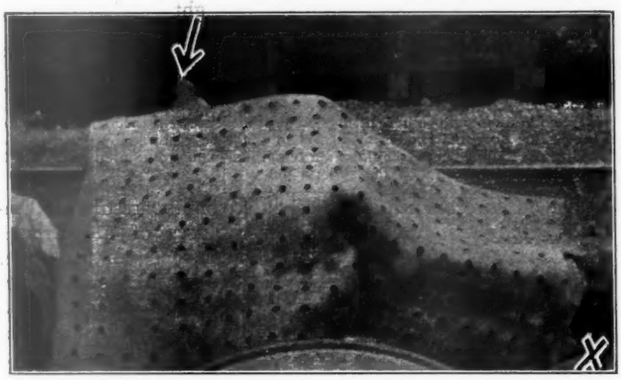
	Year ended June 30—			
	1917		1916	
Members of train crews:	Killed	Injured	Killed	Injured
Engineers	16	230	11	205
Firemen	21	304	12	225
Brakemen	13	60	9	74
Conductors	3	14	1	6
Switchmen	1	8	..	6
Roundhouse and shop employees:				
Boiler makers	..	11	1	11
Machinists	..	8	1	11
Foremen	..	1	1	3
Inspectors	..	3	..	3
Watchmen	..	5	..	8
Boiler washers	..	7	..	10
Hostlers	..	6	..	6
Other roundhouse and shop employees	2	19	1	21
Other employees	5	22	..	7
Non-employees	1	23	1	3
Total	62	721	38	599

Briefly summarizing, for the purpose of comparison, the record of accidents caused by failure of locomotives or tenders, or any part thereof, which were investigated by this bureau, as required by the law as amended, shows a total of 616 accidents, with 62 killed and 721 injured thereby. Of these accidents, 389, in which 52 persons were killed and 469 injured, were due to failure of locomotive boilers or some part or appurtenance thereof, and this may properly be compared with the record of accidents and casualties investigated by this bureau under the locomotive boiler inspection law, as shown in former annual reports. Two hundred and twenty-seven of the accidents shown in this report, in which 10 persons were killed and 252 injured, were caused by failure of some part of the locomotive or tender other than the boiler and its appurtenances, and were investigated under the amended law.

Much of the increase in the number of defective locomo-

tives and the accidents and casualties resulting from failure thereof has, no doubt, been brought about by unprecedented operating conditions, which, together with the shortage of labor and material, has made difficult the proper maintenance of locomotives.

This, however, is not a justification for the operation by



A Crown Sheet After an Explosion Due to Low Water

This crown sheet was welded by the oxy-acetylene process to the side, tube and door sheets. The arrow shows where it tore a piece out of the left side sheet and the cross shows how a small patch welded to the tube sheet was pulled off with the crown sheet.

any carrier of locomotives that are in an improper condition for service, and the fact that some carriers by diligent efforts and careful supervision of repairs have not only maintained the condition of their locomotives, but have actually improved it during the past year, thereby increasing operative efficiency, is evidence that it can be done even under the present exacting operating conditions.

The problems which have confronted this bureau in the matter of withholding locomotives from service when defective and in violation of the law, under the operating conditions which have existed since the declaration of war and during the months immediately preceding it, have been unusually difficult and have required the most careful consideration. The importance of the prompt, as well as safe, movement of trains has been constantly in mind, and every privilege consistent with the purpose of the law has been granted; first, by special instructions to inspectors to exert every effort, even to the extent of giving personal assistance when necessary, to facilitate the prompt and safe movement of traffic, and, later, with the approval of the Commission, by means of certain modifications of the inspection rules which the representatives of the carriers claimed would be beneficial to them during the period of the war.

It is to be regretted that some carriers appear to consider a congestion of traffic as a legitimate excuse for operating locomotives that are known to be in an improper condition for service and in violation of the law, and this is done to an extent that, I believe, fully justifies the statement that on such roads running repairs are neglected to an extent which, if continued, will cause serious interference with the movement of traffic during the coming winter in spite of the most diligent efforts of the limited force of Federal inspectors to enforce maintenance of locomotives as required by the law.

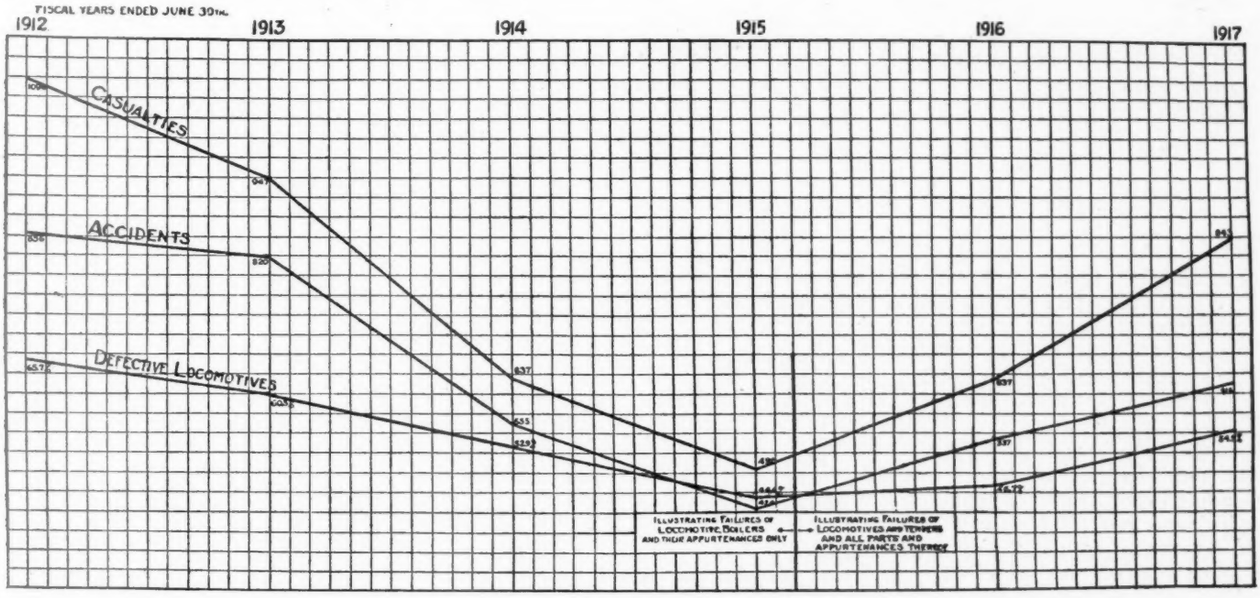
LOCOMOTIVES INSPECTED, NUMBER FOUND DEFECTIVE AND NUMBER ORDERED OUT OF SERVICE

	1917	1916
Number of locomotives inspected	47,542	52,650
Number found defective	25,909	24,685
Percentage found defective	54.5	47
Number ordered out of service	3,294	1,943

NUMBER OF ACCIDENTS, NUMBER KILLED AND NUMBER INJURED

	1917	1916
Number of accidents	616	537
Number killed	62	38
Number injured	721	599

During the year 668 applications were filed for extension of time for removal of flues, under the provisions of rule 10. Our investigation showed 56 of these locomotives in such condition that no extension could be granted under the law. Forty-eight were in such condition that the full extension requested could not be granted, but an extension for a shorter period was allowed. Fifty-four extensions were granted after defects, disclosed by our inspections, had been repaired. Thirty-three applications were withdrawn for various reasons. The remaining 477 were granted for the full period asked for. The number of extensions granted this year represents an increase of 16 per cent over those granted during the preceding fiscal year, while the number which were refused shows a decrease of 8 per cent. This indicates that a more thorough inspection is being made by railroad



Relation of Defective Locomotives to Accidents and Casualties Resulting from Locomotive Failures

companies before filing applications for such extensions.

Under rule 54, which requires a specification card containing the results of the calculations made in determining the working pressure and other necessary data to be filed, with the Chief Inspector, for each locomotive operated, and an alteration report or corrected card when any changes are made which affect the data shown, approximately 3,500 specification cards and 9,500 alteration reports were filed. These specification cards and alteration reports are carefully checked to determine whether or not the factor of safety meets the requirements of the rules, and when locomotive boilers are found in service with the factor below that required by the law, action is taken as provided therein. The importance of carefully checking specification cards and alteration reports is demonstrated by the fact that serious errors have been found in hundreds of them. In some instances locomotives have been found in service with steam pressure greater than the boilers were originally designed to carry. In a number of instances alteration reports have been filed showing patches applied in a manner which materially decreased the strength of the boiler. Investigation developed the fact that some companies did not calculate the stress on the boiler when the repairs were made and that others had improperly calculated such stresses.

In order to prevent this, we have recommended: first, that the strength of patches should be determined by a competent

Steam Leaks Due to a Cracked Cylinder Found by the Government Inspectors

person before they are applied; second, that the patch plate be the same thickness as the shell plate to which it is applied; and third, the efficiency of patch seams should equal corresponding seams in the boiler as originally designed.

Six hundred and sixteen accidents caused by failure of locomotives or tenders or some part or appurtenance thereof, including the boiler, have been investigated in the past year.

Accident investigation is only of value when the knowledge gained thereby is used to prevent similar accidents. The result of a single investigation may not be sufficiently conclusive to base a change in methods or equipment thereon, but where investigations cover numerous accidents extending over a period of years, changes can be recommended which can reasonably be expected to be of substantial value in preventing accidents of a similar character.

The similarity of the effect of accidents of certain types clearly points to improvements in construction or in methods which will promote safety in the operation of locomotives.

The advisability of recommending additional rules at this time has been given careful consideration, with a view to avoiding, as far as consistent with the purpose of the law, regulations which would require additional equipment or labor during the war, except where it has been demonstrated that both safety and efficiency will be increased thereby.

In accordance with the above the following recommendations with the reasons therefor are made:

First.—New locomotives placed in service should have a mechanically operated fire door, so constructed that it may be operated by pressure of the foot on a pedal or push button, or other suitable appliance, located in the deck or floor of the cab or tender at a suitable distance from the fire door, so that it may be conveniently operated by the fireman from his position while engaged in firing such locomotive. Locomotives now in service should be equipped with a mechanically operated fire door, as above described, the first time they are shopped for general or heavy repairs, and all locomotives should be so equipped within a reasonable time; provided, that the above recommendation should not apply to locomotives equipped with mechanical stokers nor to locomotives using oil for fuel.

Second.—Air operated power reversing gear should also have a steam connection, with an operating valve conveniently located in the cab, and so arranged that in case of air failure steam may be quickly used to operate the reversing gear.

Third.—Holes for plugs or studs in boiler sheets should have a good thread the full thickness of the sheet in which they are applied, and all plugs and studs and other fittings should be screwed through the sheet. Plugs, studs, or other boiler fittings should not be repaired by calking, and under no circumstances should an attempt be made to tighten them while there is steam pressure on the boiler.

The first recommendation is based on the result of hundreds of investigations of boiler failures of a character which permits the steam and water contained in the boiler to be discharged into the fire box. With the swing type door, which is at present largely used, such a failure invariably results in blowing the fire door open and discharging steam and boiling water, together with the contents of the fire box, into the cab of the locomotive, seriously or fatally burning persons therein. The automatic fire door will remain closed if the failure occurs while it is closed; and if the failure occurs while it is open, it will automatically close the instant the fireman's foot is removed from the operating device, thus preventing the direct discharge of steam and scalding water into the cab of the locomotive.

The second recommendation is made because defects to certain types of brake equipment, which results in the loss of main reservoir pressure, not only renders the brake inoperative, but renders the air operated reversing gear also inoperative. When this occurs on a locomotive being operated light, it results in the complete loss of control of the locomotive; and instances where this has occurred, resulting in serious accidents, have been investigated by this bureau. In one case where such steam connection had been provided it was found that it had been obstructed by placing blind gaskets in it, because it was claimed that the steam damaged the packing in the reversing cylinder. Such practices should be prohibited, and the steam connection applied and maintained so that it can be quickly used at all times.

The third recommendation is based on an investigation of more than 200 accidents, due to plugs, studs, or other boiler fittings blowing out. In a large percentage of the cases it was due to improper application, as the plug, stud, or fitting had only been screwed part way through the sheet, while in some cases not more than two or three threads were holding in the sheet.

No formal appeal from the decision of any inspector has been filed during the year.

The accompanying chart shows the relation between the percentage of locomotives found defective and the number of accidents and casualties resulting from failure thereof and illustrates the result of operating defective locomotives. It does not accurately represent the result of the law, because prior to September 4, 1915, the law only applied to locomotive boilers and their appurtenances, while since that date it includes the entire locomotive and tender and all their parts and appurtenances; therefore, the increase in the percentage of locomotives found defective, also in the accidents and casualties since that date is largely due to the extension of the law to include the entire locomotive and tender.

It should be noted that the record of accidents and casualties at the close of the fiscal year ended June 30, 1917, is well below the record for 1912, although the record for 1917 includes 227 accidents and 262 casualties, due to failure of parts of the locomotive and tender which were not covered by the original boiler inspection law.

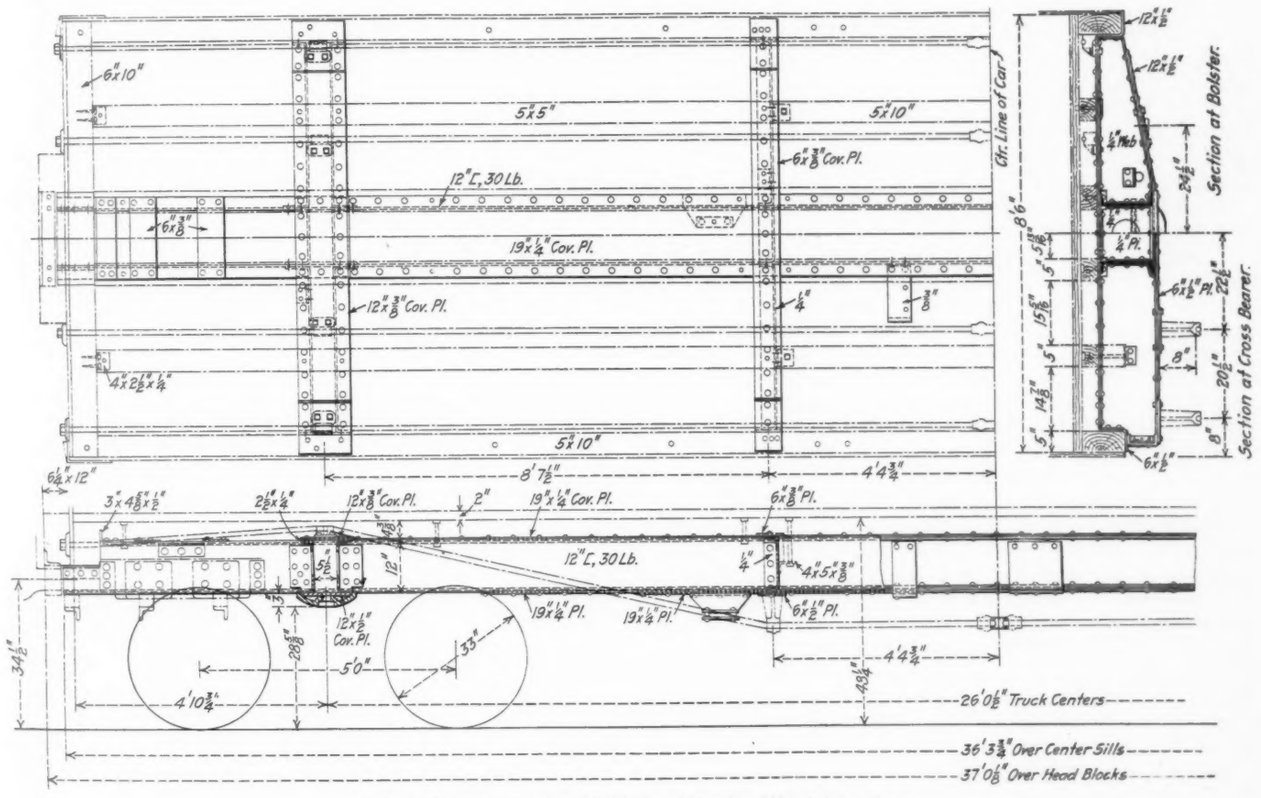
DELAWARE & HUDSON STEEL UNDERFRAME FOR WOOD FREIGHT CARS

In rebuilding and repairing cars of 60,000 lb. capacity of the box and single-hopper bottom type, and also for tandem hopper cars of 85,000 lb. capacity, the Delaware & Hudson is applying the steel underframe shown in the accompanying illustration.

For the box cars, the underframe of which is shown in the drawing, the steel portion consists of the center sills and the body bolsters. The wooden end and side sills are retained and the latter are trussed in the usual manner. The steel portion of the underframing includes the center sills, body bolster and cross bearers for carrying the side sills. The center sills are formed of 12 in. channels. On top of these channels there is a cover plate ¼ in. thick extending from end to end of the center sill, and an additional plate of the same thickness running from cross bearer to cross bearer. There is also a ⅜-in. cover plate riveted to the bottom flanges of the channels which is 19 ft. 3 in. long.

The bolsters are pressed steel of U section and are held together by cover plates at the top and bottom. The cross bearers are of the same design except that but one section is used instead of two; this being stiffened with a cover plate at the top and bottom.

The underframe used for the hopper coal cars is of the same general design. The details are similar but are of necessity somewhat differently arranged and 15-in. channels are used instead of 12-in. channels for the center sills.



Steel Reinforcement for 60,000 lb. Capacity Wood Box Cars

HOT BOXES*

BY H. L. SHIPMAN
Equipment Inspector, Atchison, Topeka & Santa Fe

The question of hot boxes is so common and has been discussed so frequently that some of the fundamental principles are overlooked. One of the chief of these is the brass not fitting the journal when it is applied. Very few journal bearings have 50 per cent bearing area when applied, and most of them do not have 30 per cent bearing area. The belief that the brass will come to a good bearing in a hundred miles, is not true.

The weight of the load will not crush the babbitt lining

*From a paper presented before the Car Foremen's Association of Chicago.

until it becomes hot. A journal is supposed to carry a load of from 350 to 400 lb. per square in. on the projected area of the brass. If this pressure is multiplied by three or four, there is then a pressure of from 1,000 to 1,500 lb. per square inch. This pressure will generate more heat than the brass is able to conduct away, especially if a little grit or dirt is present in the packing; consequently, the temperature of the bearing will rise until the conditions change. Usually the temperature will rise until the babbitt becomes soft enough to crush under the weight of the load. As soon as the bearing area spreads, the pressure per square inch is reduced and the brass cools.

The melting temperature of the solder that holds the lining in the brass is about 350 deg. F., which is 75 deg. F. less than the melting temperature of the lining. Therefore, it often happens that the solder melts and is squeezed out from between the lining and the brass, before the lining becomes soft enough to crush under the weight of the load. When this occurs the crown of the lining is left loose in the brass. After the lining has become loose it is cracked by the shocks of switching and rough handling, or by brake applications. Brake applications under certain conditions will crack the lining after it is loose but will not break the brass itself.

A journal bearing with a loose lining, under favorable conditions, may run for months after the original damage is done before it will give any more trouble. As soon as the lining begins to shell out, however, the bearing should be removed. When the lining gives away in spots, the pressure is concentrated at the other points of contact, raising it above a safe pressure for a bearing and consequently increasing the liability to heat.

Another condition that is generally overlooked, is that the lining of a brass that has been in service a year or so, gradually becomes filled with grit and sand. These fine particles become embedded in the babbitt and increase the normal running temperature of the bearing above what it would be, were the particles of grit not present. It has been found difficult to rebore the lining of these old bearings, on account of dulling the cutting edge of high speed steel, because grit and sand are embedded in the babbitt.

Dirt and sand cannot embed themselves in the brass, therefore, to avoid trouble, a brass should be removed as soon as the babbitt is worn out. Where the box lids were tight and good dust guards in place, there have been cases of bearings that ran cool on the brass, after the lining had worn out. Dust guards and box lids must be maintained in order to keep out the grit and dirt. Sand may not cause a hot box, but it increases the liability of heating.

The next point is the matter of "preparedness." It should always be our endeavor to have the journal boxes in condition to run, before the trip is begun and not wait until trouble occurs. This will necessitate a little extra work at the starting terminal, but will make less work on the road and less at the next terminal, thereby making a saving. It is a question of whether the work is to be done on the road or on the repair track. It must be done somewhere, and the repair track is the proper place to do it. Every time there is a hot box two pounds of waste and over a gallon of oil are burned up, which at present amounts to about 60 cents per hot box. To this should be added the cost of the brasses, delays, cut journal, wrecks, etc.

Recently a case has been called to my attention, where a 70 ft. steel underframe coach was run over 35,000 miles without either re-oiling or repacking. Why do we oil passenger cars every 1,000 or 1,500 miles when it has been shown that a record like this can be made by skillful handling? The only answer is lack of preparation and attention.

To obtain the best results in reducing hot box trouble, it is necessary to adopt some system of inspection to insure that the packing will be pulled and the brass examined at regular intervals. The most important feature of this whole subject is to teach the employees how to care for journal bearings so as to prevent trouble, and second, how to determine the cause of a hot box after it has occurred. The car men very seldom see a hot box until it is burnt up. The train men generally report "dry packing," and do not stop to consider that the smoke by which they detect the hot box is vaporized oil. They should not expect to find the oil in the box after it has passed off as smoke. The trainmen should endeavor to determine the cause for a hot box and not just report dry packing. If they could give the real cause, then the car man would know where he is "falling down." We must have more cooperation between these two classes of employees to obtain the best results.

In order to enable the men to classify the different causes of journal bearings running hot, they have been divided into two general classes: First, hot bearings that run cool after they have been repacked; second, hot bearings that continue to run hot after they have been re-packed. The causes are listed in the order of their importance as follows:

UNDER FIRST HEADING.

a. Packing not in contact with the journal.
b. Packing caked or glazed.
c. Oil washed out of the box by the use of water.
d. Insufficient packing in the box.
e. Box packed too tightly.
f. Presence of abrasive or cutting particles in the waste.
g. Packing dry.

UNDER SECOND HEADING.

a Thread of waste under the brass.
b. Defective, broken or worn out brass.
c. Concentrated pressure due to improper fit of the brass.
d. Brass not the proper size for the journal.
e. Cut or seamy journal.
f. Bent journal or axle.
g. A "wiper" on the brass.
h. Tapered journal, causing irregular pressure on the brass.
i. Truck out of square.
j. Truck side frames out of line.
k. Crown of wedge not having the proper bearing in the box.
l. Brass not fitting the wedge.
m. Unequal distribution of the load.
n. Overloaded.

This subdivision has been made to enable a trainman to arrive at the true cause of a hot box with a greater degree of accuracy. It is our desire to prevent every hot box, but when one does occur we want to know the actual cause; then we may be able to prevent the next one. Hot box trouble can be conquered by two things only: education and preparedness.

A list of questions and answers has been prepared so as to enlighten our men on this subject and cause them to think for themselves. Our endeavor is to interest the men doing this work so as to cause them to think of what they are doing and why they do it. These questions and answers cover not only how a box should be packed, but why a box runs hot, when it should be repacked and when rebrassed.

Two prominent eastern roads are trying out a new method of packing a journal box. This is similar to the old method except that no waste is put in the outside end of the box. They claim a saving of about 14 per cent for waste and oil. This method of packing is only in the experimental stage, and should be thoroughly tested out before it is generally adopted. Whatever method of packing is adopted, the number of hot boxes will always be measured by the degree of interest and cooperation we can attain between our shop men, yard men, and train men.

DISCUSSION

The difficulty of educating employees with the large number of changes which now take place in the forces makes systematic training essential. Repacking freight cars regularly each year has given good results in eliminating hot boxes. Several members expressed the opinion that the lubrication of cars would receive more attention if there was an M. C. B. charge for the work. The record of one road showed that 10 per cent of the packing removed from freight cars was not fit to be used. Experience with clasp brakes on European roads has demonstrated that they reduce the troubles from hot boxes.

REFRIGERATOR CARS FOR THE B. & O.

Insulation Applied Without Intervening Air Spaces; Unobstructed Circulation of Air Around the Ice

THE Baltimore & Ohio has recently constructed in its own shops some refrigerator cars that contain many interesting and new features in their design. Contrary to the customary practice, the insulation throughout the car is applied without any air space between the different layers. The purpose of this arrangement is to eliminate the so-called dead air space and to better support the insulation. It has been found that it is difficult to maintain a tight car with the layers of insulation separated, on account of the constant weaving of the car, and, further, that the only *real* dead air space is in the insulation itself. By applying the various layers of the insulation directly on themselves, the construction of the car is less complicated and the insulation can be better supported, and it will not deteriorate as rapidly.

A careful study of refrigerator car design has also shown that the lading of the car will be better refrigerated if the air in the car has a direct and positive circulation. To obtain this the bulkhead of the ice chamber was made solid, with ample openings at the top and bottom, and the load is held above the floor on racks. To obtain greater effectiveness from the ice, a wire netting is provided to hold the ice, which permits a free circulation of the air around it. With the ice thus held away from the sides and end of the car, less heat is transmitted through the car walls. The bulkhead is insulated, so that it, too, will not transmit heat to the ice, but instead guide the cold air down to the bottom of the car for circulation. The insulated bulkhead is of further benefit in that it prevents to a large extent the condensation of moisture on the car side of the bulkhead, which is liable to spoil the material placed against it.

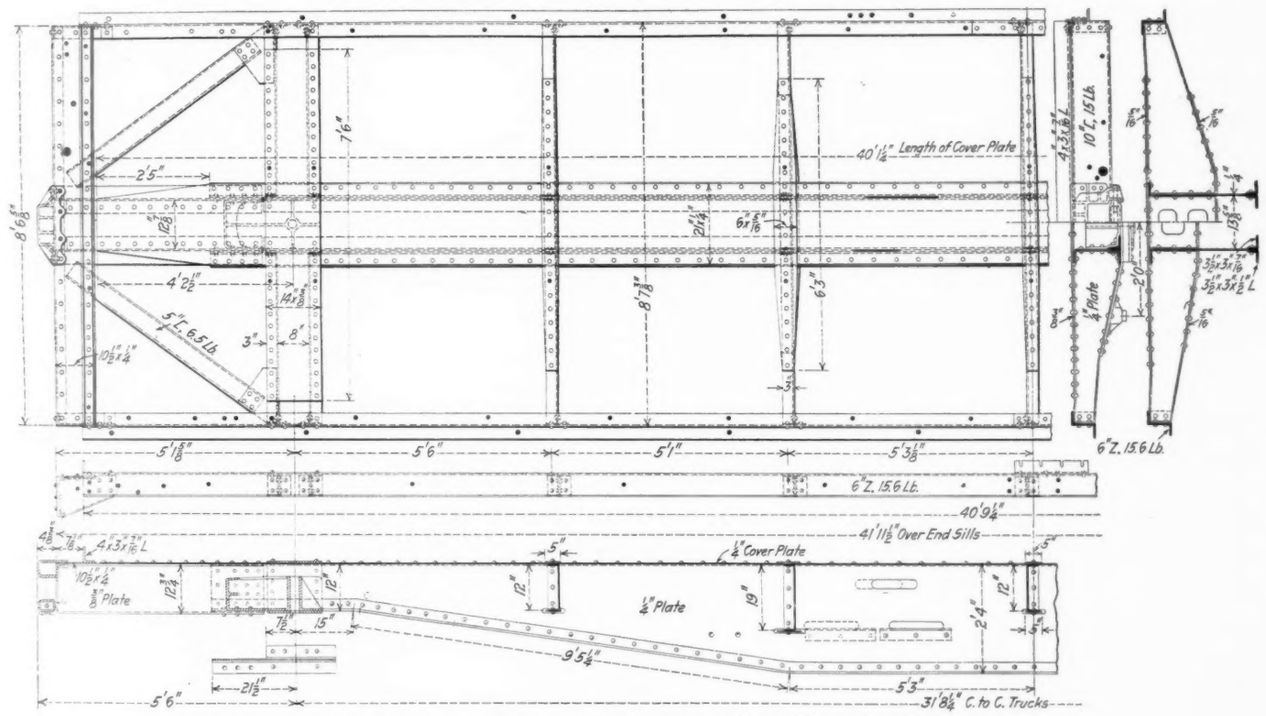
These refrigerator cars are of 70,000 pounds capacity and weigh 54,800 pounds. They have the following general dimensions:

Length inside	39 ft. 8¾ in.
Length between ice boxes	33 ft. ⅞ in.
Length of outside over body	40 ft. 10⅞ in.
Width over siding	9 ft. 3¼ in.
Width inside	8 ft. 3 in.
Width at eaves	9 ft. 5½ in.
Maximum width over side ladders	9 ft. 9½ in.
Height inside, floor to ceiling	7 ft. 6 in.
Height from rail to top of brake shaft	13 ft. 10⅛ in.
Distance from center to center of trucks	31 ft. 8¼ in.
Wheel base of truck	5 ft. 4 in.
Size of journals	5 in. by 9 in.
Height from rail to top of floor	4 ft. 1⅛ in.
Width of side door opening	4 ft. 0 in.
Length over end sill channels	41 ft. 11½ in.
Length over striking casting	42 ft. 8¼ in.

CAR FRAMING

The underframe was furnished by the Ralston Steel Car Company. It is made entirely of steel, consisting of pressed and rolled shapes. The center sill is a fish-belly girder 2 ft. 4 in. deep at the center and 12¾ in. deep at the ends. The webs are of ¼ in. plate flanged outward at the top to receive the coverplate. They extend a short distance back of the body bolsters, where they are riveted to the ⅜-in. draft sills. The coverplate is 21 in. wide by ¼ in. thick and extends between the end sills. The bottom of the center sill webs are reinforced by 3½-in. by 3-in. by ½-in. angles on the outside and 3½-in. by 3-in. by 7/16-in. angles on the inside. The body bolsters are ¼-in. pressed steel pans shaped to fit into the center and side sills. They have 14-in. by ⅜-in. top coverplates and 14-in. by ½-in. bottom coverplates. The crossbearers are ¼-in. pressed steel pans with 5/16-in. top and bottom coverplates. The side bearings are located on 48-in. centers.

The end sills are 10-in., 15-lb. channels, reinforced at the



Steel Underframe for the Baltimore & Ohio Refrigerator Cars

top by 4-in. by 3-in. by 7/16-in. angles set 7⅛ in. back of the face of the channels. The end sills are braced at the center by 5-in., 6.5-lb. channels extending back to the ends of the body bolsters. The side sills are 6-in., 15 6-lb. Z-bars.

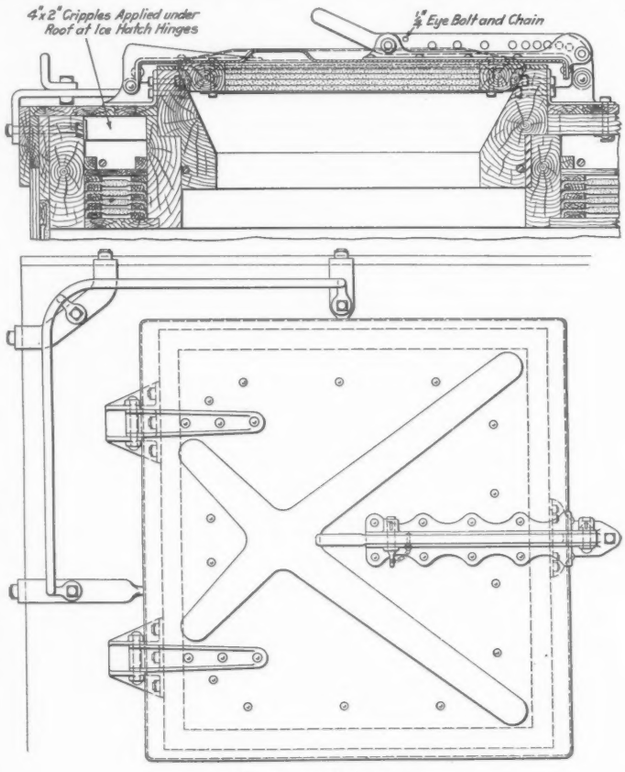
The side posts and braces are 5-in. by 2-in. Oregon fir, being set into malleable iron pockets doweled into the side and end framing. A tie rod is located at each post, extending through the side plate and side sill. The carlines are white oak, 1¾ in. thick. The ridge pole is secured to alternate carlines by ¼-in. pressed knees bolted to both the carlines and the ridge pole. The flooring, lining, sheathing and ceiling is Oregon fir. The flooring is 1¾ in. thick, and the lining, sheathing and the ceiling are 13/16 in. thick. The roofing boards are of the same material and are covered with the Murphy XLA outside metal roof. The end plates are 3 in. by 9 in., and the side plates are 3 in. by 8 in.

INSULATION

The method of insulating these cars, as stated above, is novel in contrast to the general practice followed. No attempt has been made to provide dead-air space between the successive layers of insulation, and greater care has been taken in its application.

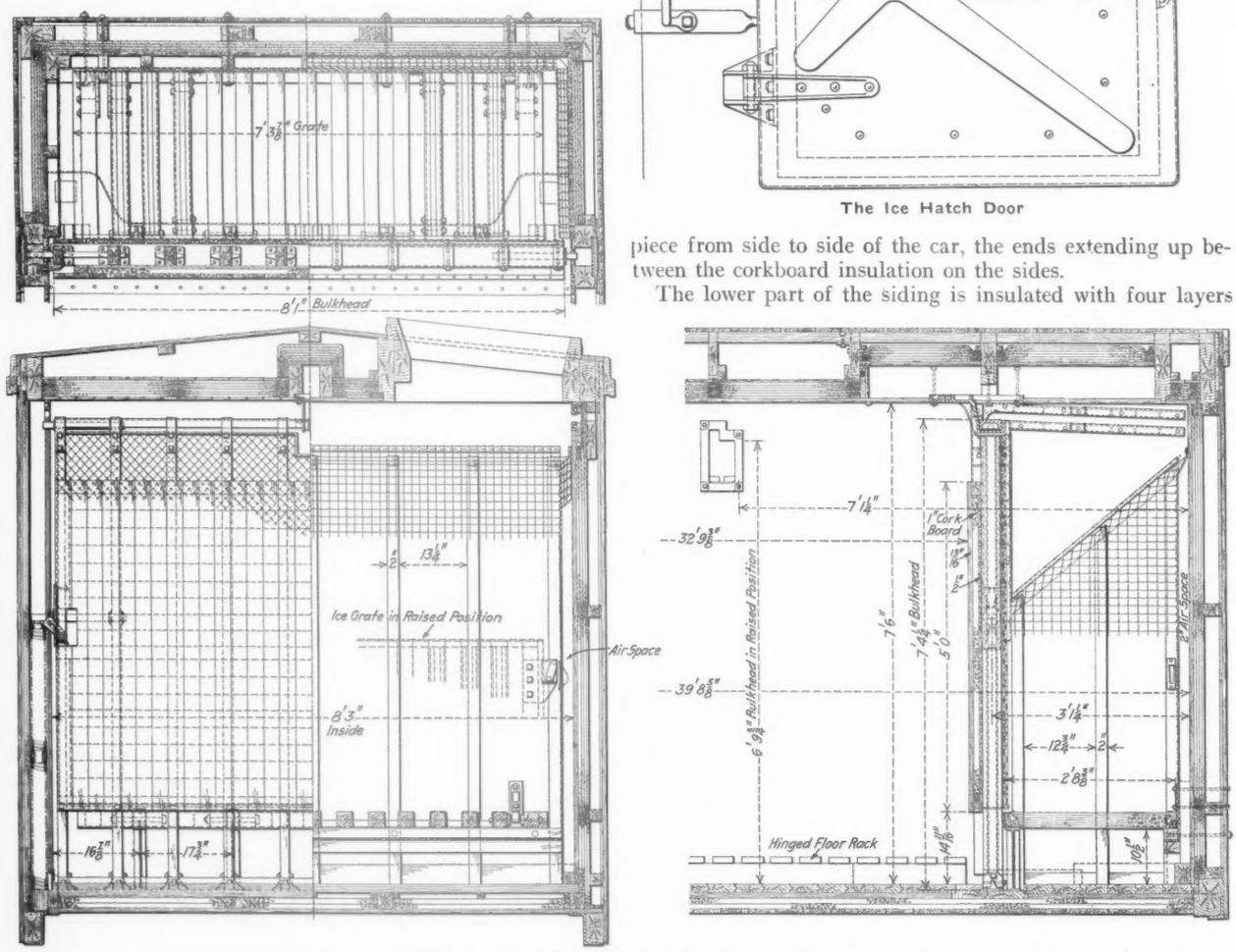
The cross sections show that below the 1¾-in. flooring there is a 1-in. air space with 1-in. by 1-in. floor strips. A layer of felt paper is applied on top of two thicknesses of 1-in. corkboard. Before the felt paper is applied the top surface of the corkboard is coated with hot odorless asphaltum to tightly seal all joints. Beneath the two 1-inch thicknesses of corkboard there is a 13/16-in. subfloor.

The 1¾-in. flooring is supported on 3-in. by 3-in. nailing strips, which are bolted directly to the subfloor and the crossbearers of the underframe. The felt paper extends in one piece from side to side of the car, the ends extending up between the corkboard insulation on the sides.



The Ice Hatch Door

The lower part of the siding is insulated with four layers of ½-in. corkboard. The inside lining is beveled at the bottom and caulked to prevent water on the inside of the car seeping through into the insulation, causing its deterioration. The felt paper extends throughout the entire side of



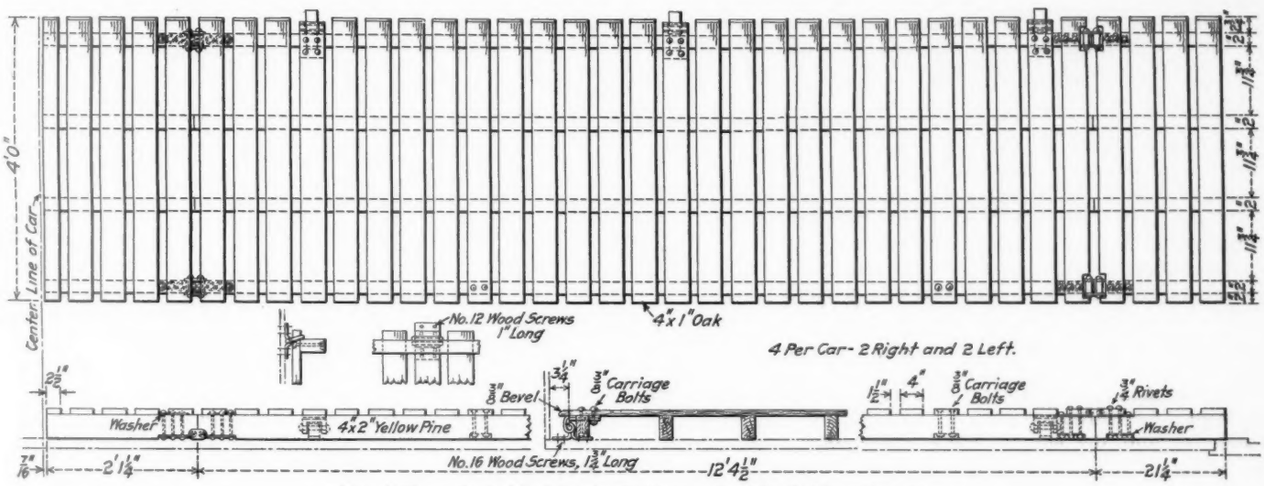
Sections Through the Ice Bunkers, Showing the Insulated Bulkhead

the car between the inside lining and the insulation. Above the corkboard there are four layers of ½-in. hair-felt, covered with asphaltum insulating paper, laid directly on each other with no air space between them. They are held at the belt rails by ⅜-in. by 2-in. furring strips, as shown in the illustrations. The insulation passes around the corners of the car in continuous pieces to better provide a tight insulated joint. At the top the outside layer of insulation is lapped up into the ceiling insulation around the side plate.

The insulation in the ceiling is heavier than that on the sides, as it has been found that the absorption of heat is greater on top of the car than on the sides. Six layers of ½-in. hair-felt are used here. These are placed directly on top of the 13/16-in. ceiling without any air spaces between them. On top of the insulation is placed a ½-in. subceiling which is nailed to the carlines. The weight of the ceiling with the insulation is too great for it to be substantially held by nails, therefore, ¾-in. by 3-in. ceiling support strips are placed at every third carline and are bolted to the carlines by ⅜-in. bolts countersunk into the carlines.

ICE BOXES

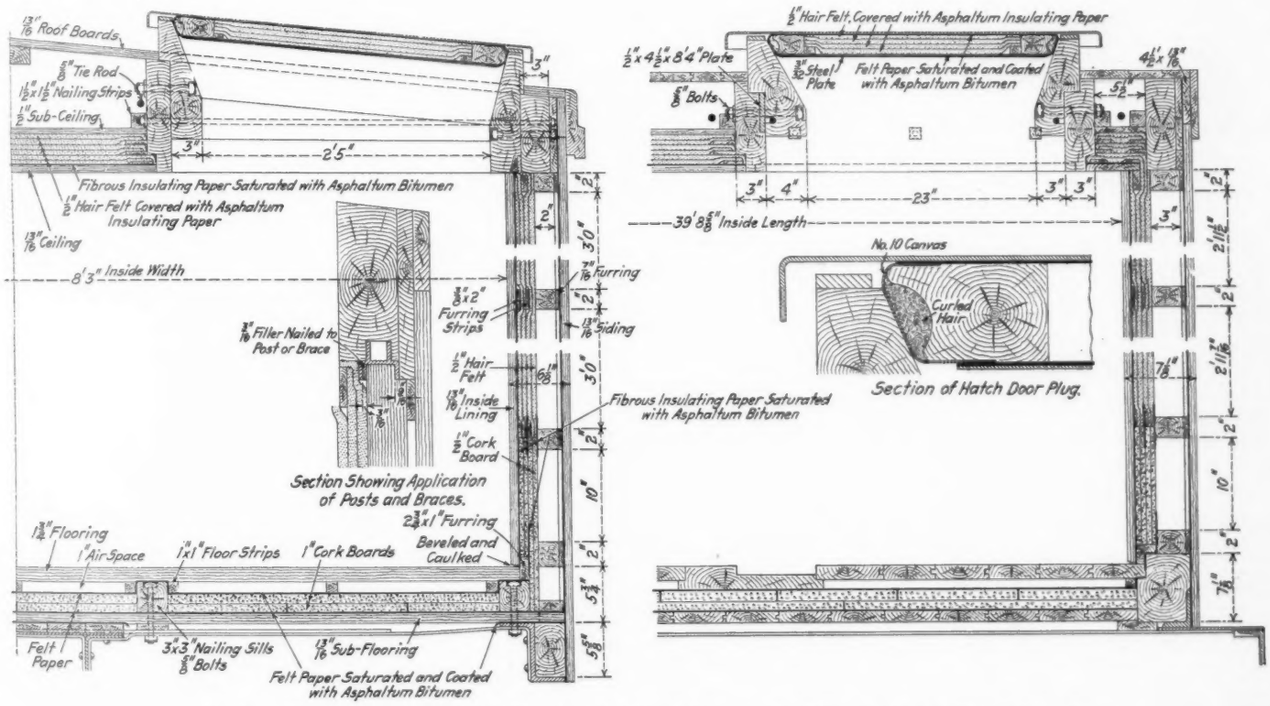
The ice boxes are of particular interest, being so constructed that a 2-in. air space completely surrounds the ice.



Hinged Floor Rack Used in the Baltimore & Ohio Refrigerator Cars

The ice is contained in a heavy wire netting, which exposes the ice to the air circulating through the car. The ice boxes are provided with a Bohn insulated collapsible bulkhead, which is 7 ft. 4¼ in. high, having an opening at the top and bottom for the circulation of air through the ice box. The insulated portion of the bulkhead is 5 ft. in height, and this consists of a 13/16-in. lining, a 1-in. layer of corkboard and a ½-in. lining.

The purpose of insulating the bulkhead is to insure that the ice bunker will not cool the perishable freight piled up



Sections Through the Ice Hatch Showing the Insulation on the Sides, Ends and Floor of the Car

against it to a lower degree of temperature than obtains in other parts of the car. This feature is an exceptionally important one, as bananas and other fruit, as well as eggs, have been known to freeze when piled up against the bulkhead of ice bunkers that were not insulated. The insulated bulkhead also effects a more positive circulation through the car.

The wire netting which holds the ice is cut away at the top to allow swinging the collapsible bulkhead into place at the top of the car. Without this type of bulkhead the netting would ordinarily be extended up to the top of the ice box.

To further assist in the positive circulation of the air, a floor rack made up of 1-in. by 4-in. boards, spaced 1½ in. apart, is hinged to the sides of the car, and when in the lowered position it is 4 in. above the floor of the car. This allows the cold air to work up through the load equally throughout all parts of the car and better refrigerates the material carried.

Considerable care has been taken to properly insulate the walls surrounding the ice box. The illustration shows how thoroughly this has been done. The runway for the collapsible bulkhead at the center of the car is insulated by six layers of insulation which extend around it. The spaces between this runway and the hatchway, and between the hatchway and the end of the car are also as thoroughly protected.

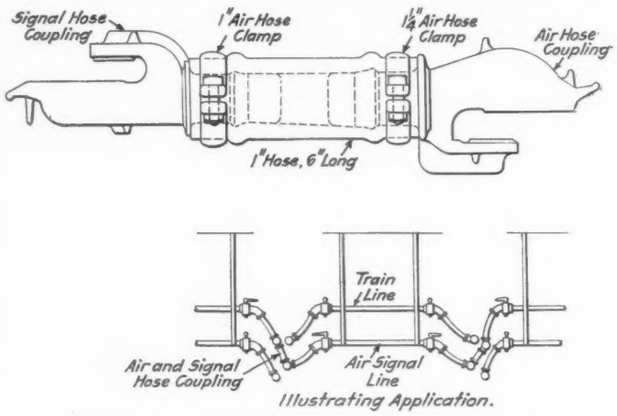
The ice hatch and door are particularly well constructed. A ½-in. plate 4½ in. by 8 ft. 4 in. extends across the car in the hatch frame at the inner side to give it strength. In addition to this a bar ⅜ in. thick by 1⅜ in. wide extends around the top of the hatch frame for reinforcement. The hatch door is made with a 3/32-in. steel plate on the underside and a ⅛-in. pressed steel plate on top, which are bolted to the door frame by ⅜-in. carriage bolts. The upper plate is ribbed to give it additional strength and is flanged downward on all four edges to protect the joints from rain. Between the steel plates four layers of ½-in. hairfelt with felt paper above and below are applied for insulation. The lock bar is so designed that the hatch door must be tightly closed before the door can be locked. A series of holes are provided in the lock bar to mesh with a hole in a bracket attached to the top coverplate of the door, to permit holding the hatch door open at desired heights when the car is used in ventilator service.

These cars are equipped with the Westinghouse type K brakes. The trucks used were taken from dismantled steel hopper cars and have 5-in. by 9-in. journals. The capacity of the trucks is 80,000 lb. The ice bunkers have a capacity of 15,000 lb. of ice.

Increased Coal Production in France.—The monthly production of coal in France has increased from 1,576,062 tons in June, 1916, to 2,345,251 tons in June, 1917, the output of the French coal mines having increased almost steadily during the intervening period.

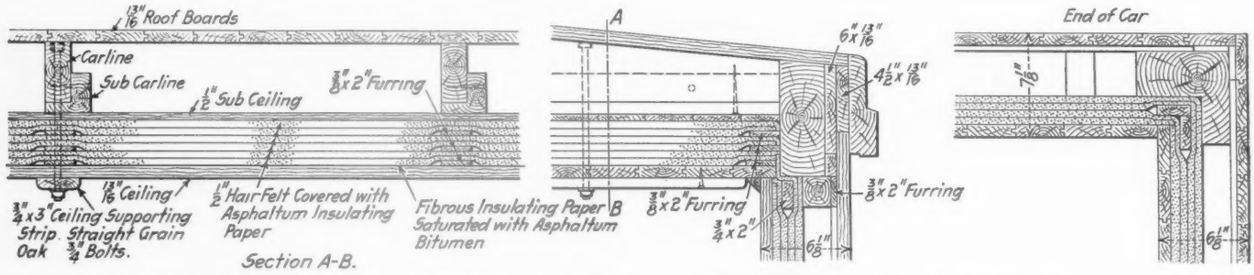
EMERGENCY AIR AND SIGNAL HOSE COUPLING

Practically all engineers are aware that in case of a break in the train line in the forward part of a passenger train the brakes on the cars behind can be operated by passing air through the signal pipe of the car on which the break has occurred. Nevertheless, when such failures take place, much time is usually lost as it is not always easy to find the proper fittings for making the change. To avoid such difficulties the Illinois Central provides that each baggage car shall carry two special couplings for connecting the air signal pipe of one car and the train pipe of the adjoining car.



Emergency Coupling and Method of Application

These consist of signal hose coupling and an air hose coupling attached to a piece of 1-in. air hose 6 in. long. With these couplings it is only necessary to uncouple the train line and signal line at the end of the damaged car and connect the signal line with the train line on the adjacent cars. The method of application as well as the construction of the coupling is shown in the illustration.



Method of Applying the Insulation to the Roof and Corners of the B. & O. Refrigerator Cars

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Effect of Labor Trouble on Coal Production.—According to a statement authorized by the Geological Survey, Department of the Interior, a direct measure of the serious effect of labor trouble is furnished by the statistics of bituminous coal production for the week ended August 18. In this week, by reason of strikes in Illinois and the Southern Appalachians, the ratio of tonnage produced to full-time capacity, as limited by present labor supply, was lowered for the country from 71.8 per cent to 62.5 per cent. In the districts directly affected the reductions were in Illinois from 70.3 per cent to 54.8 per cent and in eastern Kentucky and Tennessee from 74.2 to 10.8. Conditions in Iowa, Indiana and Ohio improved slightly, and the output percentage in western Pennsylvania declined from 78.2 to 69.4.

MODERN DRAFT GEAR REQUIREMENTS*

Advantages of a 4-in. Travel for High Capacity Gears Discussed; Methods of Testing Described

BY L. B. ENDSLEY
Professor, Railway Mechanical Engineering, University of Pittsburgh

DRAFT gears have been much discussed by the railway people for a great many years, and there are many phases of this subject. There are three things that draft gears may do in the handling of railway cars. These may be divided in general as follows:

1. Produce slack in starting trains.
2. Control slack in the movement of trains.
3. Reduce the impact force in the switching of cars.

In all of these the principle involved is the same, namely, producing the same speed in two cars that may be coming together or going apart because of differences of speed. The draft gear to be effective in doing this, must have a capacity that is relative to the difference in speed. What I mean by this is that for a difference of speed of, say, one mile per hour, a draft gear of small capacity will suffice, but if the difference in speed is 4 m.p.h., it will take a draft gear 16 times as large to prevent a shock, for the energy of a moving body is proportional to the square of its velocity.

Draft gear capacity is the number of foot-pounds of work required to just close the draft gear. It can be represented by an area, as shown in Fig. 1. The lower line of this chart represents the travel of the draft gear and the upper distance represents the force exerted on the coupler to close

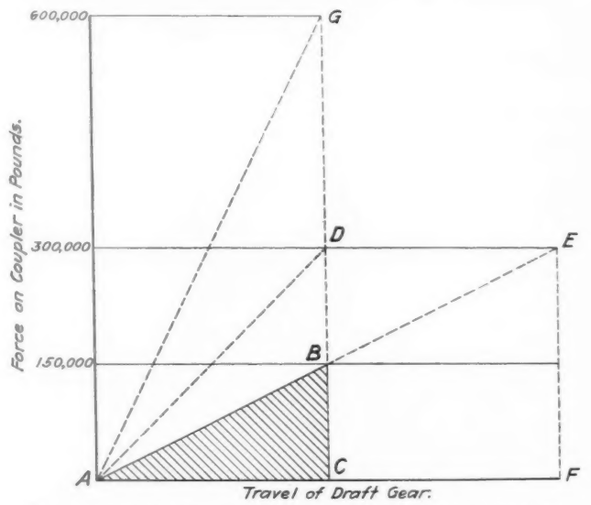


Fig. 1—Graphic Representation of Draft Gear Capacity

the draft gear. If we assume a draft gear with a travel of 2 in., or from *A* to *C* in this figure, a final pressure of 150,000 lb., or from *C* to *B*, and that the pressure necessary to close the gear under discussion was directly proportional to the movement; the line of action of the gear would be a straight line and would be represented by *AB*. The capacity of the gear then would be represented by area *ABC*. Now, if we wish to increase the capacity without increasing the slope of the line *AB*, we must increase the travel, and if we should increase the travel to double that shown in the shaded area, we would have four times as much capacity as we had before. That is, if *AC* equal half of *AF*, the area *ABC* is one-fourth of *AEF*. While if we wish to increase the capacity of the gear and not the travel, we will have to increase the slope of the line *AB* to *AD*, in order to keep this pressure 300,000 lb. or below, and will only get an area represented by *ADC*, which is only twice that of *ABC*. The slope of line *AD* is much greater than line *AB*, and should it be desired to get four times as much area as that in *ABC* and still have the same travel, it will be necessary to increase the pressure to 600,000 lb., and then the area of *AGC* will be four times *ABC*, or area *AGC* will equal *AEF*, and the capacity of these two gears will be the same. The two-inch travel gear will have twice the final force that the one with the four-inch travel will have. This final force is what a great many people have called the capacity of a draft gear. The comparison shown in Fig. 1 is ideal. It would be almost impossible to construct a draft gear that has a slope equal to line *AG*. But this figure was merely given to illustrate the advantage of gears having long travel.

If we have a draft gear that has a capacity equal to one-fourth the difference of the energy of two cars in impact, the cars will not receive a shock above the maximum force necessary to close the gear. That is, if a car is going 4 m.p.h. and strikes a car standing still, it will produce in the standing car approximately half of the speed of the moving car, or in other words, put into the standing car one-fourth of the energy that was originally in the rolling car. The rolling car will retain approximately one-fourth and coast down with the second car, but half the energy is gone and it must be absorbed in the draft gear or some part of the underframe. Of course, some of this energy may be absorbed, due to the shifting of the load, but it must be destroyed in some manner. If it is not done in the draft gear, it is bound to be done on the underframe or the coupler.

This shifting of the load amounts to considerable in some kinds of freight, such as coal and ore. Now, if the load should shift one inch, this would be equal to increasing the draft gear travel one inch; also, any give in the underframe would be equal to increasing the travel of the draft gear. Now there is considerable difference in the give of cars. Steel cars only give half as much as wooden cars below the elastic limit, assuming that both have the same ultimate strength. This fact is one thing that has been entering into wooden car construction. There has been considerable give in the bolt holes between the draft timbers and sills. Thus the car itself has been absorbing the shock and there has not been as much need for a draft gear of a large capacity. But when we are now using all steel cars with no give in the rivets, the draft gear must do the work of absorbing the difference in energy between the two cars coming together in impact or the coupler or some other part of the car will have

TABLE I

Comparison of a Car, Total Weight 150,000 Pounds

Speed in miles per hour	Approximate energy in foot-pounds	Capacity of gear in foot-pounds to just close	Approximate height of drop of 9,000 hammer to shear nine 19/32 rivets
1	5,000	1,250	4.7 in.
2	20,000	5,000	9.7 in.
3	45,000	11,250	18.0 in.
4	80,000	20,000	28.7 in.
5	125,000	31,250	44.7 in.
6	180,000	45,000	63.0 in.

*Abstract of a paper read before the Canadian Railway Club, November 13, 1917.

to do it; if the coupler is stronger than the other part of the underframe, the underframe will have to do it.

In order to illustrate what energy is necessary to be absorbed for different speeds of cars in switching service Table I is given. The first column of this table gives the speed in miles per hour; the next column gives the foot-pounds of energy in the moving car at the speed given in the first column; the third column gives the capacity of the draft gear that should be used in each car for the speed represented in the first column for two cars weighing loaded, 150,000 lb.; the last column gives the height of drop that the 9,000 lb. hammer should fall before it shears off nine 19/32 in. rivets to have the capacity given in the third column. This column was obtained by multiplying the values in the third column by 12 and dividing by 9,000 and adding 3. The first part of this deduction is to obtain the height of drop to close the draft gear. The 3 added at the end is the added height in inches that it will take to shear the rivets after the capacity of the draft gear is taken up.

Now, it will be seen that a very small capacity is necessary for one mile per hour, namely, a drop of 4.7 in. of the hammer, but a draft gear that is many times as large is required for a difference in speed of 6 m.p.h., or 63.0 in. This height should be the total fall of the hammer to just touch the dummy coupler used, plus the travel of the draft gear. That is, if the fall of the hammer was 15 in. before it started to close the gear and the travel of the gear was 3 in., the total capacity of the gear would be represented by 18 in. I, personally, think that we should take care of 4 m.p.h. switching speed in the draft gear design. If we should do this, that is, if the draft gear would just close under a speed of 4 m.p.h., it is certain that the coupler or any part of the car would never be damaged in an impact between two cars at this speed.

There is not a coupler on the market but that will stand a greater impact force than the force necessary to close any draft gear on the market today. I have given some heights of drop that a 9,000 lb. hammer should fall before it shears off one or both lugs with 9 rivets 19/32 in. in diameter. This method of testing draft gears was first used, I think, in September, 1908, at the Westinghouse Airbrake Company, but there 9/16 in. rivets were used. To my mind, this is the best method of determining the capacity of a draft gear. In this method of testing, the draft gear is mounted on two lugs that are riveted to two short pieces of channels and held upright between posts. Each lug has nine rivets, each 19/32 in. in diameter, each lug carries half of the load, and the test is made by dropping the 9,000 lb. hammer from 1 in., 2 in., 3 in., and so on, until one lug is sheared off. This occurs at about 275,000 lb., which is the average pressure that I obtained on several sets of lugs.

Now, when the 9,000 lb. hammer drops vertically on a draft gear that is supported on these two lugs that rest on a solid base with these same rivets in the lugs, they will not shear off until an approximate pressure of 275,000 lb. is reached, and in a good many tests with the same draft gear and different sets of lugs, the variation is never more than 1 in. That is, if a given gear shears off at a 16-in. drop, it might go 15 in. at another test, or if it shears off at 24 in. one time, it might go to 25 in. on another set of lugs. In other words, the variation is very small. I have conducted a test of a certain draft gear of a given make that sheared off three sets of lugs at exactly the same height, which means that this method is bound to give very accurate comparison of the capacity of different draft gears.

Up to this point in the paper, I have been talking of draft gear capacity and have not mentioned the absorbing capacity. I wish to distinguish between these two at this point. Draft gear capacity is defined as the foot-pounds of work necessary to close the gear. The absorbing capacity is that which is not given back when the draft gear is released after being closed. This feature of a draft gear can be very easily obtained from the drop of 9,000-lb. hammer by putting a recording pencil on the hammer and causing it to mark on a revolving drum. If the hammer falls 20 in. and rebounds, say 10 in., it is evident that the absorption has been half the capacity. This feature of the draft gear comes into play in controlling the slack of a long train in going up and down grades and in the starting and stopping of trains. If the slack should run in, and is not absorbed by the draft gear or underframe, it would run out under almost the same speed minus only that absorbed in the journal and rail.

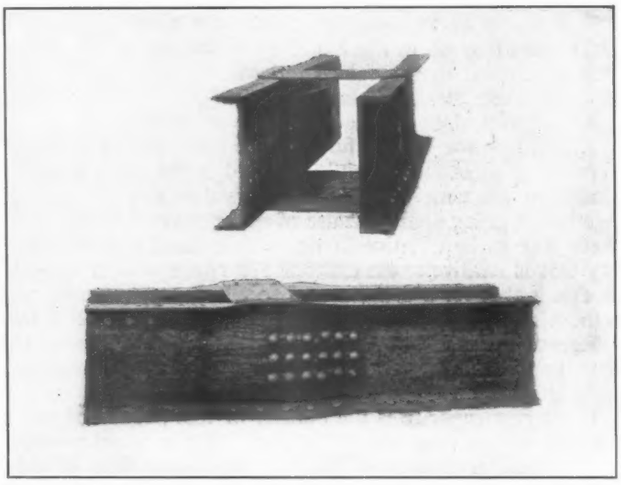


Fig. 2—Deformation of Sills with the Center Line of Draft at the Center

This brings me to a point that I have often made, and that is, that we can not expect a draft gear to last the life of the car any more than we can expect a brake-shoe to last the life of the car. No one has, as yet, discovered a metal that has any absorption of work by sliding on some other material that does not wear. Of course, some metals wear more than others under the same absorption. Some years ago I made some tests for the Brake Shoe Committee of the Master Car Builders' Association, and found some shoes with the same coefficient of friction that varied as much as 300 per cent in the loss of weight in doing a given amount of work—and this is a very good subject for study for the draft gear companies. It was found that the loss of metal increases very fast as the pressure increased and the coefficient of friction decreases as the pressure increases. We should keep the pressure between the wearing surfaces of the draft gear as low as possible and this can be done by making it as large as possible.

Some time ago the M. C. B. committee on car construction made some recommendations with regard to the center line of draft. These recommendations when applied to most cars fixed the center line of draft within 2 in. or 3 in. of the center of the sill. In order to get some information on this subject six sets of channels were made up; photographic reproductions of two of them after the tests are shown in Figs. 2 and 3. The channels were each 15 in. high and weighed 40 lb. per ft. The center line of draft of one set was placed on the center of the channel for 7½ in. from the edge and this distance from the edge was decreased by 1¼ in. until 2½ in. from the edge was obtained. Two sets of channels with the center line of draft 6¼ in. from the edge were made, one set of which did not have any tie plate. The results obtained are given in Table II. It is evident from this table that the center line of draft should be for maximum strength within 2 in. of the center line of the sills, and that

the tie plates are of great value in strengthening the sills. By looking at Fig. 2 it will be seen that when the line of draft is on the center, both upper and lower flanges are bending, while with the line of draft 3¾ in. from the edge, as shown in Fig. 3, nearly all of the bending is at a place in the edge of the channel closest to the line of draft. This is nothing extraordinary, for you all know that if you eccentrically load any two pieces of steel, the one close to the load is going to take most of the work and the ultimate strength of the system is reduced.

TABLE II

Maximum pressure obtained in impact test made on 15-in. 40-lb. channel with 15,000-lb. pendulum hammer, with different center line of draft.

Distance from edge of channel	Maximum pressure obtained before the channel failed
7½ in.	1,155,000 lb.
6¼ in.	1,125,000 lb.
5 in.	960,000 lb.
3¾ in.	723,000 lb.
2½ in.	662,000 lb.
6¼ in. without tie plate	744,000 lb.

SUMMARY

I have attempted in this paper to bring to your minds two or three very important things in the selection of draft gears and the design of freight cars. One of the most important things is—we will have to increase the travel of the draft gear above that thought sufficient some years ago. Some years ago it was felt that 2 in. or 2¼ in. was as much travel as we should have. But I am ready today to say that we should have at least 4 in. of travel, or possibly more, in any draft gear for modern cars. It is evident that this is going to allow us to materially increase the gear capacity.

Another thing of importance to the railway men today is to know what capacity of draft gear they are getting. I am confident that the best method for them to use is the rivet-shearing test, as already described. The number of rivets does not enter into the subject. What they should have is a set of lugs that will shear off just above the force which is necessary to close the gear under test. I can conceive how a gear can be designed for a final pressure of 350,000 lb., then a test of rivets shearing off at 275,000 lb. would not be fair. But in any design of a lug, the lug should be made much stronger than the rivets in order that the lugs will not bend down and the gear show a false capacity. I can see how a lug may be built and give false capacity of draft gear, but the lugs should be designed stronger than the rivets. I myself, have not found a draft gear today but that will close before it shears off nine 19/32 in. rivets. However, there may be some such gear on the market.

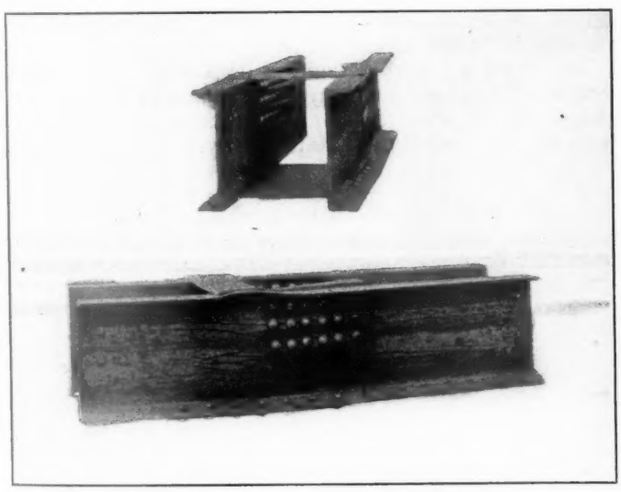


Fig. 3—Deformation of Sills with the Center Line of Draft 3¾ in. Down from the Top of the Sills

One thing that is important in the design of a freight car is that the underframe of the car should be made stronger than the coupler. It has been the coupler in the past that has been saving the car after the draft gear went solid. The men who repair cars appreciate the large number of couplers that fail. I am wondering if when we put on the new M. C. B. coupler it is not going to be the underframe of the car instead of the coupler that is going to fail when the draft gear goes solid. Especially is this true if we move the center line of draft out from the center of the sills or leave off the tie plate, as shown in the latter part of this paper, because then the pressure of only 662,000 lb. destroys the sills with the center line of draft 2½ in. from the edge of the channel. The new coupler will stand this and more in compression, which means that it will not be the coupler but the underframe that fails, and it will cost considerably more for repairs than the coupler.

I assume that everybody here knows that a friction draft gear is superior to a spring gear, but I do not believe that all of you know how much this difference is. The highest capacity spring gear in use, made of two M. C. B. class *G* springs, will fully protect your 100,000 lb. car and lading at a switching speed of a little less than 2 m.p.h. There are friction draft gears in general use on thousands of cars that will protect this same car and lading at 4.5 m.p.h. Also, there are many gears on the market that will fall between these two extremes, and each of these gears has a definite speed at which it will protect the car. But if you should attempt to switch cars at 4 m.p.h. while equipped with a spring draft gear that only protects the car at a little less than 2 m.p.h., the coupler, underframe and lading are bound to suffer. Either the coupler or underframe will fail if this speed of switching is kept up. On the other hand, should this same car be equipped with the highest capacity gear, mentioned above, it could be switched at 4 m.p.h. without any damage to the underframe or to the coupler.

Unless we put on a car a draft gear of sufficient capacity to keep it from going solid, the force that car will stand is going to be limited by the strength of the weakest part. If this is the coupler it will be from 400,000 to 700,000 lb. on most couplers in service, or if the car be equipped with the new M. C. B. coupler type *D*, this force will be from 600,000 to 1,000,000 lb. Now, if it be the underframe that is weakest, and this may occur if the design is not correct, this pressure will be a little less than that given above for the strength of the coupler. But in any case, this force may be 600,000 lb. Now, if the impact force and shock is 600,000 lb. and the weight of the car is 150,000 lb., the end pressure per pound of car weight and lading will be 4 lb. per pound of weight, or will be equivalent to standing a car on end that has four times as much load in it as the car in question contained. This is what has been knocking out the ends of cars, damaging roofs, side walls, and racking the car in general and on account of insufficient draft gear protection. Now, if the travel and capacity of the draft gear is enough to keep this end force down to 300,000 lb., it would result in practically no damage to the car.

More care must be given the draft gear in the manner of inspection and repairs in order that it may do the work which it was put on for, and which it will do if kept in repair. It may mean new gears or parts of gears, and there will be some expense attached to this inspection and upkeep, but the saving in repairs to other parts of the car is bound to more than make up for this expense.

DISCUSSION

Many favorable comments were made on the paper and it was characterized as a contribution which would materially aid in the study of the draft gear question. Several of the members called particular attention to the need of high

capacity gears. James Coleman, superintendent car department of the Grand Trunk, said that undoubtedly 70 per cent of the indeterminate damage to the lading is due to the fact that the cars in which it is carried are equipped with draft gears of too small capacity. When the amount paid out for claims for damage of this sort is considered, it will show that this question is deserving of careful thought. He claimed that no spring gear is strong enough to withstand the operating conditions as they are found today.

C. W. Van Buren, general master car builder of the Canadian Pacific, brought out the fact that damage to equipment and lading is due to a large extent to the rough handling of the equipment by the yard forces. While speaking in favor of the friction gear he stated that it must be properly inspected and maintained in good condition.

R. W. Burnett, master car builder of the Delaware & Hudson, called attention to the necessity of careful attention being given the draft gear attachments, as they, and particularly the yokes, are responsible for some of the draft gear failures. He also called attention to the wear that takes place in a friction gear and the need for proper inspection and repairs.

G. E. Smart, master car builder, Canadian Government Railways, strongly favored the friction draft gear for modern equipment. There is an economic limit between the speed at which cars should be switched in the yard and the cost of repairs to the cars caused by the treatment they receive, which should be considered. He favored particularly the use of the metal draft arm in all cases where wooden cars are built.

Among other points brought out in the discussion was that concerning a means for automatically taking up the slack in all friction draft gear due to its wear. The slacks caused by the 4-in. travel recommended by Professor Endsley in his paper was questioned. Professor Endsley answered this by stating that the slack causing the damage to equipment was that to which no resistance was offered. With the draft gear maintained in condition, its 4-in. travel would always be made against some resistance, thus the travel of the draft gear is not as undesirable as the slack or lost motion between the cars when starting trains.

Professor Endsley also again brought out clearly the necessity of providing a center sill under the car that will be stronger than the coupler, so that if anything is to fail it will be the coupler, the idea being to have that part fail which may be repaired the more easily. He recommended a center sill channel of substantial web. For instance, it will be better to have two 12-in., 40-lb. channels than two 15-in., 40-lb. channels, as tests have shown that the former will stand a higher stress than the latter.

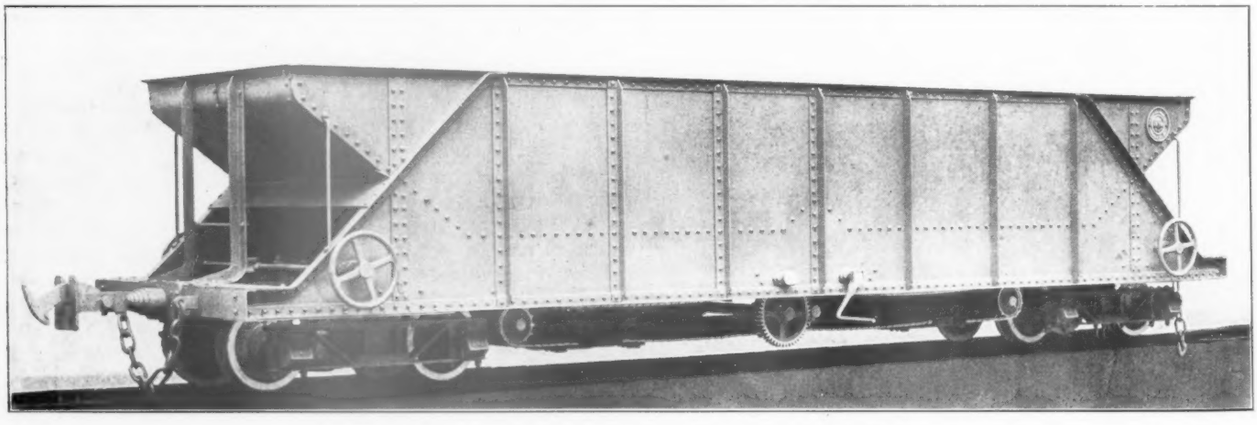
NARROW GAGE STEEL HOPPER CAR

Capacity of 40,000 Lb. Obtained on a Track Gage of Two Feet; for Carrying Mine Products in Burma

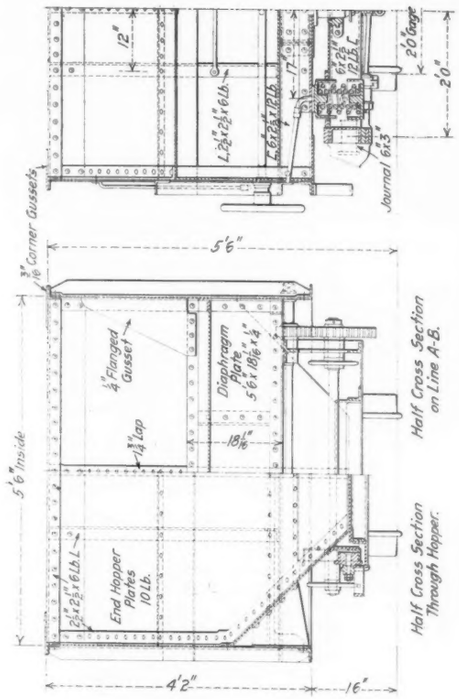
BY FREDERICK C. COLEMAN

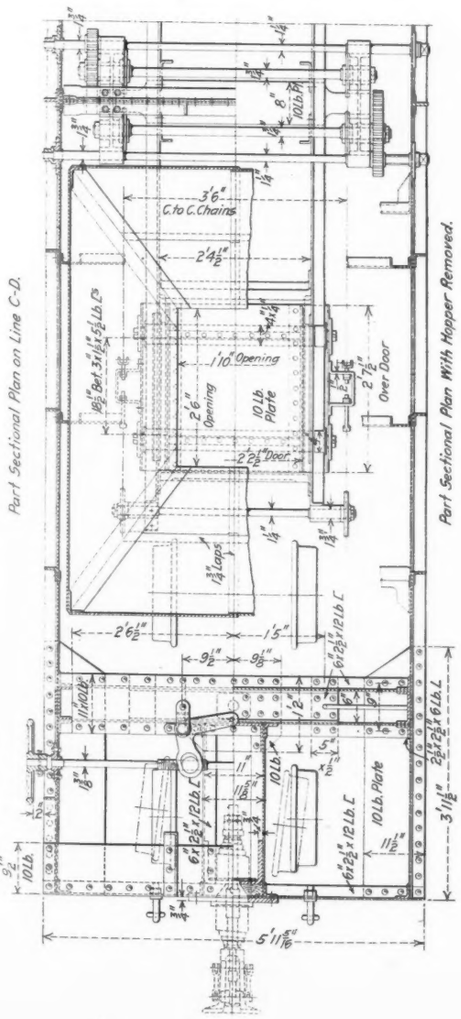
ONE of the many interesting narrow-gage railways in India is that connecting the Burma railways at Namyao station with Bawdin, where are situated the Burma mines. This railway is 51 miles in length and is of 2-ft. gage. The ruling gradient is 4 per cent, the minimum curvature is of 90-ft. radius, and flat-bottomed rails weighing 41 lb. to the yard are used. The principal outward traffic consists of lead, silver, zinc ore,—the product of the mines,—and lead bullion, whilst the inward traffic consists of machinery and general stores for the mines, including 6,000 to 7,000 tons of coke per annum for use at the mine smelters. At Namtu, the headquarters of the Burma Mines Company, is a large lead smelting and silver refining plant, and a concentrating mill and an electric power installation are also in course of completion.

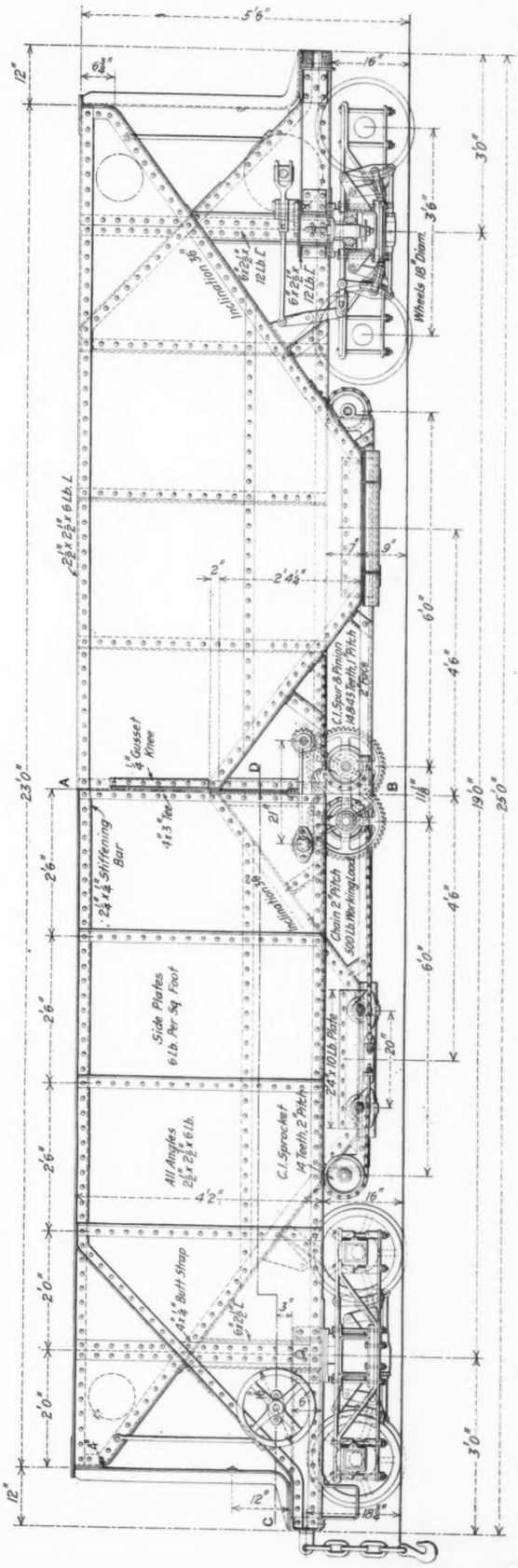
The trains are worked under a despatching system, and with night running the railway is now handling 900 to 1,000 (long) tons of traffic daily. Arrangements are in hand to increase this capacity to 2,000 tons daily. This considerable development of traffic has called for the introduction of more powerful locomotives and larger freight cars, and a number of all-steel double-hopper self-discharging cars of 40,000 lb. to 44,000 lb. capacity were ordered in Great Britain and are now in successful operation. These cars, supplied by F. R. Rand & Company, Limited, of Westminster, were built by the Blake Boiler, Wagon & Engineer-



A 24-in. Gage Steel Hopper Car for Service in Burma







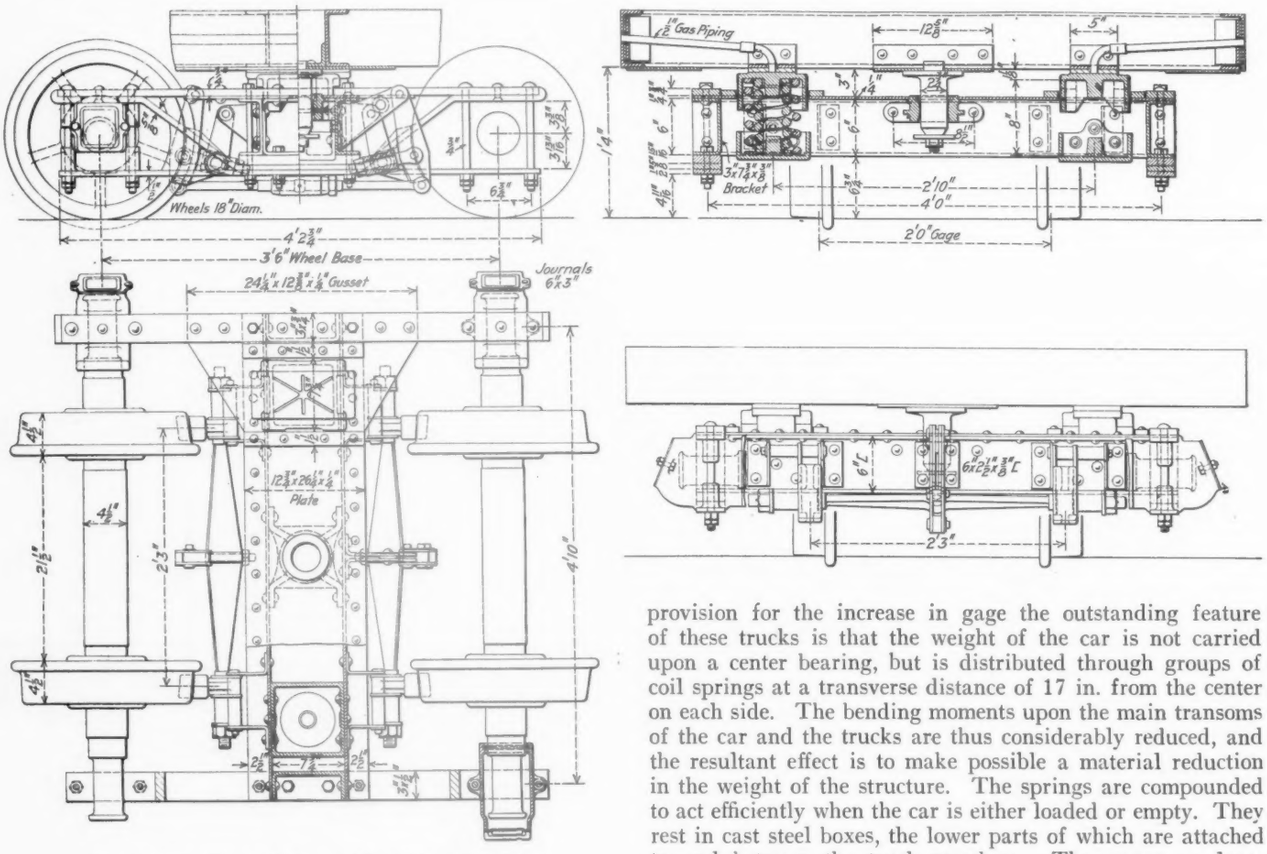
General Arrangement of the Narrow Gage Hopper Car

ing Company, Limited, of Darlington, England, to the designs of G. H. Sheffield, of 38 Victoria Street, London, and according to the Sheffield-Twinberrow system. The following are the leading dimensions:

Length over end sills	25 ft.
Length over buffers and couplings	28 ft. 8 in.
Width, inside	5 ft. 6 in.
Width, over side frames	5 ft. 11¼ in.
Center of trucks	19 ft.
Truck wheelbase	3 ft. 6 in.
Diameter of wheels on tread	18 in.
Journals	3 in. by 6 in.
Centers of journals	4 ft.
Weight of car complete	13,200 lb.
Carrying capacity	40 000 lb. to 44,000 lb.

The general arrangement drawing shows that the hoppers are 9 ft. between centers. The inclination of the sides and ends of the hoppers is 36 deg. and the openings are placed horizontally 7 in. below the sills. Horizontal doors cover the bottoms of the hoppers.

Each door runs on four rollers carried upon angle bar guides, which are riveted to the framing of the hoppers.



The Truck and Details of the Load Suspension

The horizontal flange of the angle is turned outward so that no dust or part of the load can fall on the guide rail. At each side of the door is a channel bar sill, arranged so that the web passes beneath the rail while the pins of the rollers are fixed to the outer vertical flange. The sliding doors are connected independently to a single reduction winch, by means of chains and sprockets. The winches are actuated from either side of the car by short handles, which fit on the square nuts at each end of the turning shafts. A single operator can work the doors standing clear of the car. The opening or closing of the hoppers may be regulated to any degree, or may be cut off entirely when any desired portion of the load has been run out. The hopper sheets, which act as a bracing for the lower flanges of the sides, are ¼ in. thick, and the door plates are of a similar thickness. Throughout the general structure of these cars, including the door arrangement, only five British standard sections are employed, this comparing favorably with recent examples of double hopper cars, built in England, which contain as many as 17 standard sections. As the cars are for service over severe grades, powerful screw brakes, operated from either side, are provided at each end of the car and brake blocks are applied to all of the wheels. The standard coupler in use on the Burma Railway is also employed on the hopper cars.

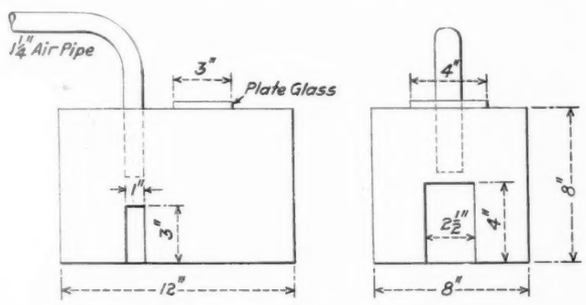
The trucks are designed to permit of the eventual conversion from 2-ft. to 2-ft. 6-in. gage. To effect this change it will only be necessary to renew the wheels, as the axles are designed sufficiently long and the journals so located that the new wheel centers may be spaced out 3 in. further toward the bearings on each side. The brake hangers and brake beams are fitted with ferrules, which will be transferred from the outside of the brake blocks and hangers to the inside, as required for the increase in the gage. Aside from the provision for the increase in gage the outstanding feature of these trucks is that the weight of the car is not carried upon a center bearing, but is distributed through groups of coil springs at a transverse distance of 17 in. from the center on each side. The bending moments upon the main transoms of the car and the trucks are thus considerably reduced, and the resultant effect is to make possible a material reduction in the weight of the structure. The springs are compounded to act efficiently when the car is either loaded or empty. They rest in cast steel boxes, the lower parts of which are attached to and between the truck members. The upper, or loose portions of the boxes are provided with large rubbing surfaces which have a sliding contact with corresponding rubbing pieces upon the car transoms. On the drawing of the truck it will be seen that provision has been made for the lubrication of these bearings. Tilting action is allowed for to the extent of the clearance between the center pins and pivot castings, and the spring boxes and side checks on the transoms of the trucks. There is provision for lateral and end movement to suit track inequalities or superelevation.

Rolled steel axles having a tensile strength of 76,200 lb. to 80,600 lb., are employed, together with chilled iron wheels. The wheels are fixed on to the axles at a pressure of not less than 45 tons. Cast steel journal boxes are provided with key plates above the brasses and they are suitable for either pad or waste packing lubrication.

SHOP PRACTICE

SHIELD FOR TEMPERING BLAST

There is considerable danger of workmen's eyes being injured by sparks flying from high speed steel tools when they are being tempered in an air blast. The use of goggles while doing this work is inconvenient, and to do away with the necessity of wearing them the shield shown below is used



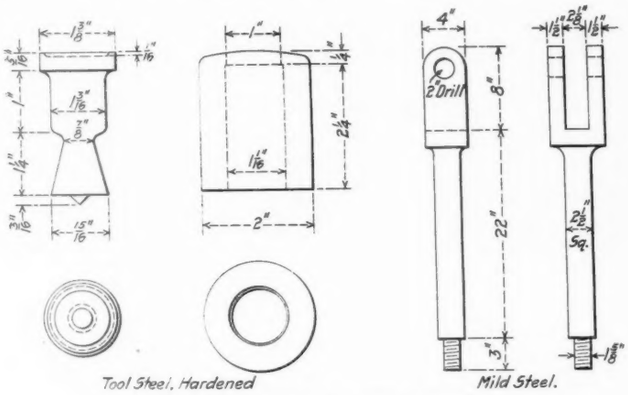
Shield in Which Tools Are Placed When Tempering

at the Boone shop of the Chicago & North Western. This encloses the tool almost completely and does away with all danger from sparks. With the two openings any tool of ordinary size can readily be handled.

PNEUMATIC PUNCHING MACHINE

BY FRANK J. BORER

The photograph and sketches illustrate a pneumatic punching machine which has now been in use for more than a year at the Elizabethport shops of the Central Railroad of



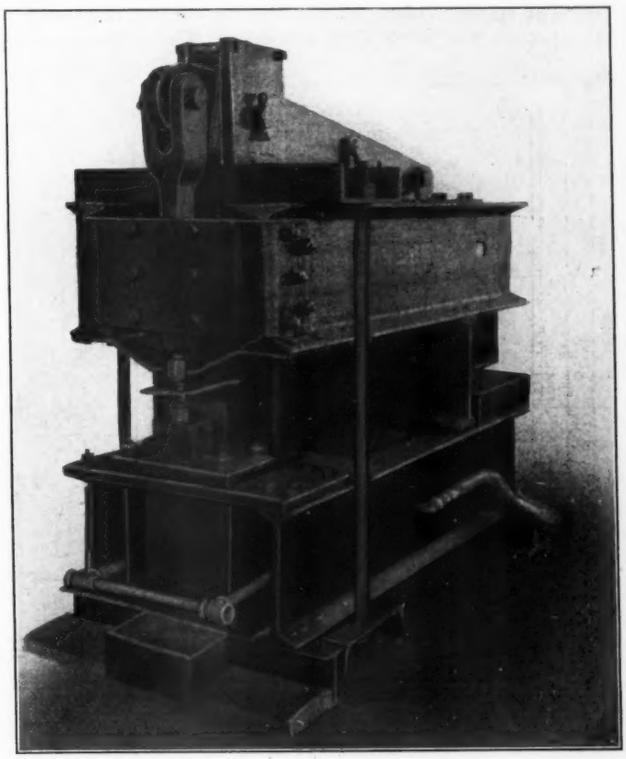
Detail of Punch, Die and Plunger

New Jersey and has given entire satisfaction as regards service and output of work.

The frame of the machine is constructed from second hand bridge material and the few forgings required were made in the blacksmith shop. A second hand 16-in. air brake cylinder was used and no material had to be purchased to construct the machine, thus reducing the cost of construction considerably.

It is not the purpose of the writer to advocate the construction of a machine of this kind instead of purchasing a regular punching machine, but rather to draw attention to the fact that one or more machines of this kind could be used to advantage in small shops, in repair yards, scrap yards, etc., where the expense of a regular punching machine would be too great, or where other difficulties, such as obtaining the necessary power, proper foundation and housing, limited floor space and the like would prohibit the purchase of a punching machine of the standard type.

The pneumatic punching machine shown here does not

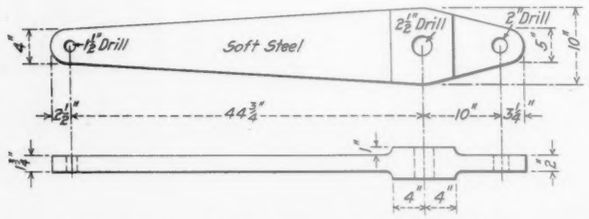


Pneumatic Punch Machine

need a special foundation and, in fact, can be made portable. Its capacity is sufficient to punch 15/16-in. holes through ½-in. iron or steel plates or its equivalent, with 90 lb. of air pressure. The power is obtained from the regular shop air supply line with a 1⅛-in. hose of suitable length. It is connected to the inlet part of a Westinghouse straight air brake valve. (It was found that this style of valve is more durable, easier to operate, and requires less repairs than does a three-way cock.) The air brake valve controls a 16-in. brake cylinder. When air is admitted to the cylinder, the

piston engages a lever having a proportion of 4½ to 1. Punch dies and punches are made of the same dimensions and shape as those furnished with standard machines.

The straight air brake valve is operated by foot power, a spring attachment keeping the handle of the valve in the release position when not in use.

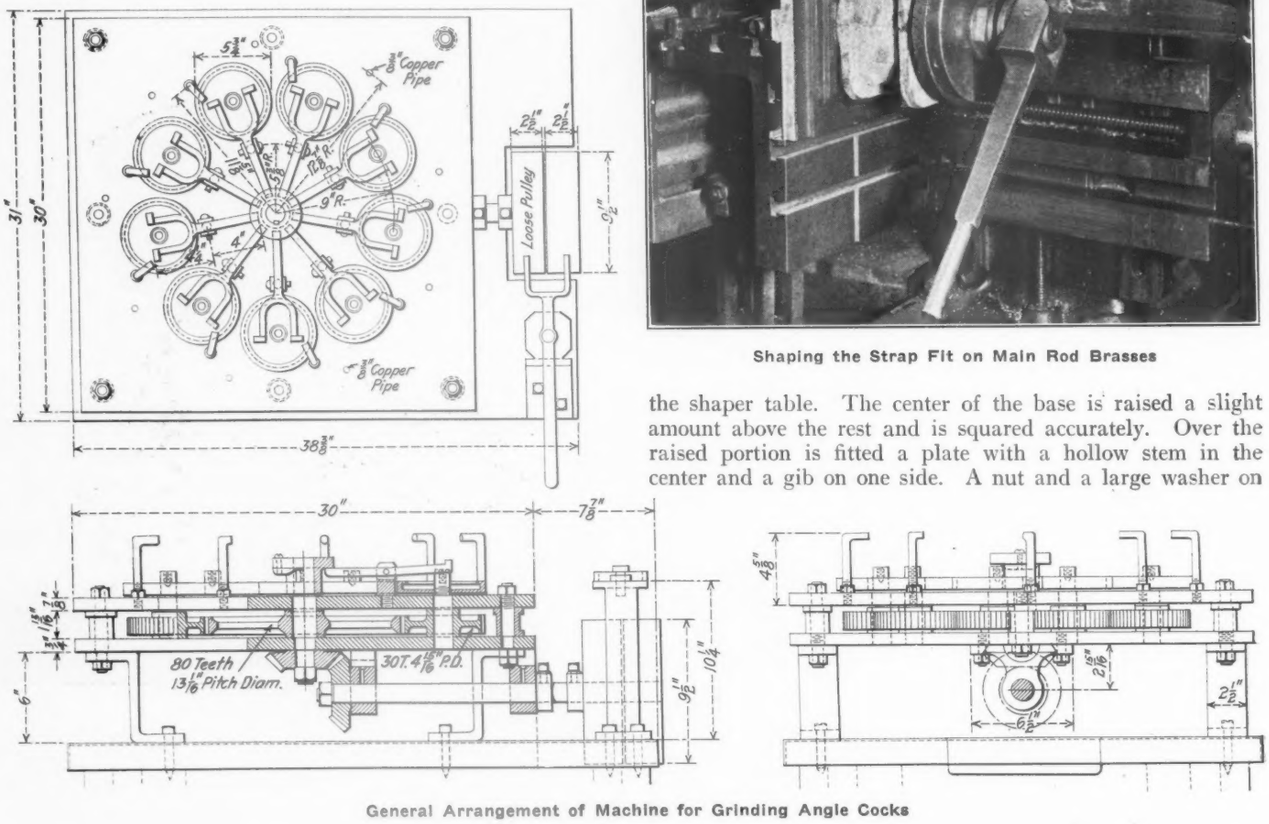


Driving Lever of the Pneumatic Punch Machine

The machine occupies a floor space of 3 ft. by 5 ft. and is about 5 ft. 6 in. high.

ANGLE COCK GRINDING MACHINE

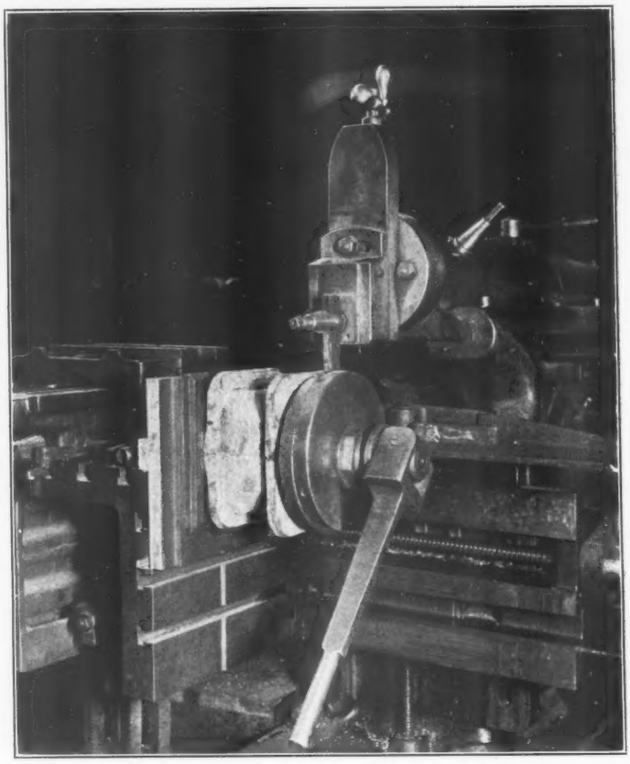
At the Topeka shops of the Atchison, Topeka & Santa Fe angle cocks are ground on a simple machine designed and built in the shop. The general arrangement of the device is shown in the drawing below. After the angle cocks have been taken apart and cleaned, the keys are placed on the upright spindles, nine in number, in which short studs of the proper size have been screwed. The bodies are then placed over the keys and the machine is started. The bodies are kept from turning by the stops placed beside each spindle and every two and two-thirds revolutions of the key the body is lifted by the cam on the center shaft striking the forked levers, which are pivoted between the spindles and the main shaft and in the normal position rest under the body of the angle cock. The excess grinding compound is caught in the recessed discs on the spindles. Oil is led to the spindle bearings through small copper pipes and grooves in the bearing plates.



General Arrangement of Machine for Grinding Angle Cocks

CHUCK FOR SHAPING MAIN ROD BRASSES

The device shown in the illustration below is in use at the Havelock (Neb.) shops of the Chicago, Burlington & Quincy, and has been found very useful for shaping back end main rod brasses. The base of the chuck is bolted to the side of the shaper table. The center of the base is raised a slight amount above the rest and is squared accurately. Over the raised portion is fitted a plate with a hollow stem in the center and a gib on one side. A nut and a large washer on the stem furnish a means for holding the brasses, while a stud running through the center is used to hold the plate to the base. Thus the operations of clamping the brass and turning the plate are entirely independent. When the brass is once set up it can be finished on all four sides by turning the plate.



Shaping the Strap Fit on Main Rod Brasses

DECREASING ENGINE TERMINAL DELAY

Prize Winning Papers in Competition; The Need of Organization and Supervision Strongly Emphasized

THE following papers are those awarded prizes in the competition which closed October 22. This competition was conducted for the purpose of bringing out ideas which would be of immediate assistance to our readers in putting locomotives through their own terminals with despatch. There were thirteen papers presented in the competition, most of which were good. Those which have been accepted for publication will be published in future issues.

IMPROVE TERMINAL FACILITIES AND INCREASE SUPERVISION

BY O. T. DICKENS

(First Prizes)

In planning to get the quickest possible turning of power at terminals it should not be necessary to go into the details of the procedure followed at any particular place, as the layout and capacity of terminals differ, also the regulations under which the terminal officers work are different on many railroads. The following suggestions are given with a view of getting the best results under every condition.

There are a great many things to be considered. The condition of the power, the conditions under which the power is being worked, the terminal and engine house conditions, and the terminal, shop and operating staff. The condition which the power is in, is perhaps the most vital and should receive the earnest attention of all concerned. If we are to move trains over the road in the shortest time we must keep the power in good condition. In order to do this we must have at the head of the mechanical department men who thoroughly understand their business and who realize that the success or failure of the most important and the most vital proposition our country and its Allies have ever had to handle depends to a large extent upon them. They must be assisted by men who will not lose sight of the same fact and these men in their turn must instill the same spirit into the rank and file coming under them. The executive abilities of each and every man must be used to the fullest extent and the forces must be organized to get the maximum results. Men who encourage poor work in order to gain time are only losing time in the end and their work only ends in disaster. These men must be educated or put aside to make room for those who are willing and anxious to live up to the requirements of the times.

We will assume that we are entering into the movement at the terminal with power in good condition and this condition must be such that the power can be kept out of the main shops for general repairs until it can be handled without delay. If we are to get the maximum results power must not be held out of service awaiting repairs. With this condition, there is no reason why it should not make considerably more mileage than it did formerly. In other emergencies power has been kept out of the shop several months longer than was originally intended and surely in this emergency we can do better. The track and shop conditions at the engine terminal should be such that the locomotives may be received, repaired and made ready for service with despatch. It may be possible to redesign the engine terminal but some of the necessary helps which the roundhouse foreman has been requesting for some time may be furnished.

Ashpits which are continually full cause endless delay. They discourage the workmen and cause them to be indifferent as they see how indifferent the management is to such things. The ashpits should be kept clean and put into condition so they may be easily kept clean. The same thing applies to a good many out of date appliances in the engine terminals and particularly to machine and hand tools. Some of the items which will go a long way towards making the prompt despatching of locomotives possible are steam grate shakers, up-to-date coaling and sanding facilities, good roomy ashpits, turntables which accommodate the largest power used on the division and which are equipped with power tractors, washout plants for washing with hot water, an engine washing plant, and autogenous welding apparatus. The use of brick arches will also assist greatly. The

supervision of the repair work should be in the hands of men who know how to get the best results from the facilities and who are able to devise methods to otherwise shorten the time required to do the work without sacrificing the quality of that work. The roundhouse staff must be organized so that from the time the power arrives at the shop track there is no time lost.

Supervision must commence from the time the locomotive is placed on the house track and must be carried on until it is turned out again for service. A competent staff of hostlers should be maintained who will handle the locomotive quickly. They should be kept informed by means of bulletin boards what repairs are necessary to each locomotive in order to place them on the proper track in the house. Engine inspectors must perform their duties quickly and at the same time make intelligent work reports. No time should be lost in assigning the workmen to their various duties and where ever possible the work should be specialized. Power which is in condition to turn without repairs should be given preference in handling and it would be desirable where possible to handle this power separately from that which must go into the house for repairs, washout, boiler tests, or other work which necessitates keeping it out of service for a time. Power may be run over two divisions if the road conditions will permit, with a saving in time at the terminals and a decrease in the coal consumption.

If every move made is watched closely we can get a large increase in the efficiency of every terminal, be it up-to-date or otherwise, and the question of supervision should be carefully considered. Supervision does not mean driving men; it means educating them and the workmen are the better for it. By constantly checking the movement of power on the incoming and outgoing tracks and by having foremen see that the repair work is promptly and properly done, more will done to expedite the quick handling of power than anything else. We cannot expect to get very much in the way of new equipment and therefore must make the best out of the existing conditions excepting that we should eliminate any condition which hampers the movement. The night conditions should be brought up to, as nearly as possible, the conditions which prevail in the day time. Adequate lighting in the engine house and the surroundings is of considerable importance; the efficiency of the staff depends on it more than any other condition. The night force too should receive the same attention in regard to organization and supervision as the day force. Our railroads are not in the habit of closing down from sunset to sunrise yet if we were to compare the day and night force and the work required of them in some of our terminals we would wonder that power was moved during the night at all.

We must not forget there are others besides the mechanical forces who are responsible for the delay of locomotives at terminals. The despatcher's office has been found to be one of the most important places to look to for improvement in the conditions we are discussing. If any obstacles are placed in the way of trains making a reasonable time over the division they frequently lead to defects in the locomotives which add considerably to the time taken to repair them at terminals. For instance, locomotives held at sidings during cold weather have a tendency to develop leaky boiler tubes and this is one of the most frequent causes of engine failures or of excessive time preparing power for service. The terminal facilities should be studied and improvements made which will permit the power to be delivered promptly to the engine house from the train and vice versa. Power which takes from twenty to forty minutes to be so delivered one half mile is unduly delayed and the condition responsible for this should not be tolerated. Yardmasters should make it a point not to delay power and should see that their subordinates are not allowed to do so by blocking the tracks. The condition in which the power is left by the enginemen on the engine house track should be watched and the enginemen should be encouraged to help all they possibly can. By tightening up loose nuts, setting up wedges, keying up brasses or tightening joints, they can be of material assistance. The road foreman of engines should devote his whole time to the power in order that the mechanical department may have the benefit of his experience and help, and be kept better informed on the condition of the power through his reports. The number of road foremen required for each division has been poorly calculated and the work required of them has been too great. In many cases we should have two and three road foremen where now we have but one; and even at that the railroad company would be financially better off and the motive power would be kept in better condition.

The labor situation is serious and must not be overlooked. Experience in hiring men for enginehouse work shows that it is hard to get experienced machinists, fitters, and boilermakers. Men who are fitted for general repair shops are often unfitted for running repair work. To overcome this trouble apprentices to the trades mentioned should be required to put in the last six or eight months in engine houses. Enginemen will also be hard to get and on roads where assigning of crews to locomotives is practiced the pooling system should be followed. Power tied up ten to twelve hours for the crews' rest in order to allow assigned crews to follow their engines is not a good policy and on a division of one hundred and fifty miles or over of single track the crews cannot possibly follow their engines without rest. The pooling system will not likely find favor with the mechanical department officers but there does not appear to be any other way out of the question with the present power and man shortage. The stringent rules made by the Federal authorities for the maintenance of power will require revision if we are to turn power quickly. This can very easily be done without danger.

The relations between the officers and staff of the operating and mechanical department must be the best. Too often we see some over zealous operating officer unjustly criticizing the mechanical department and here we find one of the greatest handicaps which confronts the mechanical officers. The division on which this condition is allowed to exist will not be able to meet the present requirements. It must be distinctly understood that the responsibility for the success of the railroad rests with all the departments and if there is a weak link, all should assist to strengthen it and not to further weaken it by improper and unfair criticism. What we require today are officers who will aid as well as criticise. The purchasing and stores department also have their difficulties and many allowances will have to be made, yet it should be borne in mind that no effort must be spared to keep the mechanical department supplied with necessary material. The heads of these two departments should work together in an endeavor to alleviate the material shortage and wherever possible material must be reclaimed and subsitutes used.

To sum up the situation the following would appear to be the requirements:

Improve as much as possible the terminal and shop facilities including the building of long inspection pits, where the inspection and repairing may be carried on outside of the engine house when weather permits. These pits should be built on incoming and outgoing tracks and should be used to the limit.

Eliminate conditions which hamper the work.

Apply labor saving devices in the shops and on the locomotives.

Improve the organization and increase the supervision.

These requirements together with the friendly relations

of all departments will insure that power will not be delayed at terminals or on the road.

GETTING THE LOCOMOTIVES THROUGH THE TERMINAL

BY T. S. GRANT
Foreman, New York Central, Watertown, N. Y.

(Second Prize)

The man in charge of the engine terminal at the present time has more responsibility than he ever had before. The transportation department have more cars to handle which must be handled without delays at the terminals. The engine house foreman must make the necessary repairs to the locomotives and turn them in the least possible time. On account of the heavy service the amount of repair work has materially increased.

To make these increased repairs successfully and despatch the locomotives with less terminal lay-over than has previously been allowed, the work must be systematized, the organization must be such that the greatest efficiency is obtained.

To best meet the requirements for a large engine house, there should be an outside inspection pit with the engineer's work report office located near by. There should be an assistant engine house foreman and five gang foremen; one in charge of pistons, valves, piston rod and valve stem packing, crossheads, guides and valve motion work; one in charge of rod work; one in charge of wedges, binders and driving journal bearings; one in charge of springs, spring rigging, engine truck wheels and bearings, tank wheels and bearings, pilot and tank beams and pilots, etc., and one in charge of cab and pipe work. These foremen should be numbered, one, two, three, four and five respectively. In addition to this there should be an air brake gang.

With the outside inspection pit the air brake inspector can test the pump and all air appliances on the locomotive while it is under steam and has a full pressure of air, while the engine and boiler inspectors are making their inspection. The assistant engine house foreman should, on the arrival of a locomotive, consult the work report book noting all defects reported. He should call the air and boiler inspectors' attention to any defects reported which come under their jurisdiction, and also make an inspection of the other defects in conjunction with the engine inspector, while the other inspectors are doing their work.

Rod pounds and blows reported should be examined and located while the locomotive is being put on and taken from the ash pit and into engine house. The assistant engine house foreman should follow the locomotive into engine house, placing it in the stall best adapted to make the required repairs, and spot the locomotive so the repairs may be made easily. He should then report all work that should be done, except the boiler work, which would have been written up by the work report clerk, to the engine house foremen.

Forty-five minutes after the arrival of a locomotive at the terminal, allowing ten minutes for taking coal and sand, fifteen minutes on the inspection pit and twenty minutes for dumping the grates and putting the locomotive in the house, the engine house foreman should be able to give a very close estimate as to the time the locomotive would again be ready for service. My experience has been that the most lost motion occurs at this stage of the terminal work, as the engine house foreman does not know what work is necessary on the locomotive, and the locomotive is not always placed in the proper stall by the hostler to do the required work to the best advantage. With an assistant engine house foreman and an outside inspection pit this lost motion can be eliminated.

The assistant engine house foreman would require about thirty minutes for each engine handled in this manner, but with an assistant to act as messenger, he could cover the required duties in twenty minutes, or thirty-five engines in twelve hours, allowing lunch time.

The boiler inspector after making his report to the work report clerk should immediately report all boiler defects to the boilermaker foreman. He knows the general condition of the flues and fireboxes on all the locomotives, and if the practice of dumping an engine at the end of each trip is followed, as it should be, he knows that there will not be many plugged flues. As the present time almost all flues are welded, they are not often found leaking. In most cases his repairs will consist of caulking the mudring or a few staybolts, or making repairs to the front end or grates.

		Machinery									Engine to be ordered	Boiler						
Stall	Engine	Gang #1	Gang #2	Gang #3	Gang #4	Gang #5	Air Work	Greaser	Carpenter	Misc.		Washout	Gang #5	Cool Down	Fill Up	Front End and Ash Pan	Caulking	Clean Flues	Fire Up
1	411	☐ X	☐	☐	☐	☐	☐	☐ OK	☐ X	☐ J.S.	2 P.M.	Yes	OK	~~Yes~~		OK		OK	
2	212	☐	☐ X	☐ X	☐	☐ X	☐ OK	☐ OK	☐	☐	1 30 P.M.	Yes	OK	Yes		OK	OK	OK	OK
3		☐	☐	☐	☐	☐	☐	☐	☐	☐									
4	4720	☐ X	☐ X	☐	☐ X	☐	☐ OK	☐ OK	☐	☐ C.D.	11 30 A.M.	Yes	OK	~~Yes~~	OK		OK	OK	
16																			

Work Board for Engine House Repairs

Immediately upon receiving the work slips, the engine house foreman should classify and distribute them into the receptacles provided for them on the working board, of which a diagram is shown, and, if necessary, to cool down boiler for throttle, gauge cocks or any other mountings to so advise the boiler maker foreman. He should then decide when the locomotive will be ready for despatching.

It is not necessary to go into detail in regard to the manner of doing the work or the time required, the essential point now is to get the men started on the work and to see that it is completed in the time given. The gang foremen must watch the board as closely as possible and distribute their men so that the work will be done on time. When the work is started on any locomotive, the slips are to be removed from the pocket, and a cross placed in the space adjoining. This will signify that a part of that gang is covering the work on that particular locomotive; but the slips are not to be removed until the work is started. In the column headed, "Miscellaneous," the engine house foreman will place the initials of the workmen in the line opposite the engine number to which the work is given.

Immediately upon completing their work, the different gang foremen, carpenter or workmen having miscellaneous

slips, will erase the cross or initials placed in the line opposite the locomotive number, which will signify that their work is completed. The air gang and greasers will "O. K." each locomotive opposite the engine number in their respective columns. On the boiler work side of the board, the items as shown by the different headings will be marked "O. K." on the line opposite the engine number when the work is completed and gang number five, which is shown on each side of the board, will do likewise when they are ready to have the boiler filled and fired. The different gang foremen should consult the engine house foreman on all jobs out of the ordinary or when they are tied up on some particular job. The doping, filling of grease cups, headlights and markers should be taken care of at the same time under an overseer. This gang to be known as the greasers. By this system several of the gangs would be doing their work on the locomotive at the same time to eliminate long terminal lay-overs.

In addition to the running repair work board, a board should be maintained in the engine house showing all locomotives in for repairs which will require twenty-four hours or more to complete. This should show the work required and should be corrected each morning as the repairs are made. Locomotives in this class should have all necessary side rod bushings applied, the throttle ground, flues rewelded and all other repairs of this nature made, to assure short turns on the following trips.

Good tools, properly cared for, are as essential in this emergency as good men and a good system. They should be handled from a tool-room centrally located, with the attendants constantly on duty, using a checking system for the distribution of all company tools.

Keeping the engine house and pits clean is a great help to a workman; he will accomplish much more good work in a clean pit than he would crawling over a pile of cinders or stumbling over something on the floor. Have a place for everything and keep everything in its place.

At the present time, more so than ever before, it is necessary to follow all the work closely in every detail and to assist the workmen by offering suggestions wherever possible to increase their efficiency. A proper supply of the necessary tools and supplies is also necessary. The proper co-operation between the night and the day forces is of the most vital importance. On changing shifts the engine house and boilermaker foremen should give to their successor a transfer sheet showing the true condition of all locomotives in the terminal at that time.

Improper conditions found and reported by either terminal or night foremen should not be considered as complaints, for by knowing of these conditions they are enabled to make the proper corrections which will be for their benefit as well as that of the service.

In the present emergency, when the railroad companies are going to get more miles between shopping than ever before, it will be necessary to transfer both men and machinery to the engine houses, as this is where the work must be done.

HANDLING LOCOMOTIVES AT TERMINALS

BY K. R. MITCHELL

(Third Prize)

The time a locomotive spends in a terminal commences and ends with the operating department, in consequence of which treatment of the subject of engine terminal delay should properly be divided into two parts; the mechanical or strictly engine house end of it and the operating end. The writer being immediately concerned with the mechanical end will confine this article to that phase of the subject except for that part of the operating end which is inseparable from it.

It is vitally important that perfect co-operation exist between the yard and engine house forces if the best results are to be obtained. The yard master being the first one in control of a locomotive after its arrival with a train should see that there is no delay in sending it to the engine house. If the work is to be done with the fewest possible number of locomotives this is a very important matter as every few minutes' delay in receiving a locomotive from the yard means a great deal to the engine house foreman.

Rather than burden this article with a description of the details of handling locomotives which are common to all engine houses only the more dominant methods that actually affect or influence the time of handling locomotives as used at a fair sized engine house with which the writer is connected will be featured.

The first work done on the locomotive after it is received at the engine house is at the inspection pit or pits, as two are necessary if locomotives are to be inspected expeditiously during times of congestion. It is not possible to reduce the time of inspecting to less than six or eight minutes as that is the minimum time in which the air brake test can be made strictly in conformance with Federal requirements. However, by having one or more machinists or helpers at the inspection pit quite a little work may be done in the way of tightening up bolts and nuts and any other small jobs which will reduce the time it is necessary to keep locomotives in the engine house. Sometimes this will make it possible to run a locomotive direct from the ash pit to the storage yard, avoiding the engine house altogether. An inspection of the sponging and the necessary attention to the journal boxes of tender trucks may similarly be given at this time.

Reports of the work to be done on the locomotive which are made by the inspectors on properly printed forms are "shot" by air tube to the office of the engine house foreman. This give the foreman and his assistants information that will enable them to make the necessary provision for the disposal of the locomotives in advance of their arrival at the turntable. At the same time the hostler who receives the locomotives from the crew ascertains whether or not the boiler is due for washing, whether the stay bolts are to be tested or if, for any other cause, the fire should be drawn. He likewise sends a report to the office by air tube and the necessary instructions are telephoned to the ash pit before the arrival of the locomotive at that point. A clerk accompanying the inspectors noting the defects found and subsequently transferring his notes to the printed form or even entering them directly on it may profitably be employed at times of congestion to save the time spent by the inspectors in writing their reports.

An adequate force of fire cleaners should be maintained at the ash pits to prevent the accumulation of locomotives between that point and the inspection pits. Assistance may be given the ash pit force with a resulting saving in time at times of congestion to help in disposing of the cinders. Quite some time may be saved by dumping the cinders directly into the pits and cleaning them out by means of a travelling crane equipped with suitable clam-shell bucket. By this method the passage of the locomotives over the pits is not obstructed by buckets to be hoisted out of the pits by air hoists or other stationary means and cinders may be removed at any point throughout the length of the pits. The piecework system of payment has been found to be of advantage both in decreasing the time and cost of doing the work. At engine houses where the coaling facilities are unfortunately placed between the ashpits and turntable only strict supervision can keep the time the locomotives are being coaled down to a minimum.

During congested periods it is essential that the foreman or his assistants give his personal attention to the entire movement of locomotives between the inspection pits and turntable or the time of handling will increase considerably.

This is more particularly true in winter as the men are then working at a disadvantage and require not only encouragement but the sympathy of the foreman to keep them up to their best efforts. Unfailing good humor and tact on the part of the foreman under such conditions as well as the authority that is his by virtue of his position will work wonders in "keeping things moving." It has been found advisable to place a gang-leader in charge of the hostlers, engine preparers and ashpit men at night, as operations are not naturally performed as smoothly and rapidly during the dark hours as they are in the daylight.

The reports of the enginemen and inspectors which have reached the office before the locomotives are placed in the house are taken by a clerk who is trained for the position. He records the repairs to be made on various printed cards according to the class of men who will make the repairs. For instance, all boiler work is written on one card, air brake work on another, machinist work on still another, etc. These cards are then given to the respective gang leaders, who are thus informed ahead of the arrival of the locomotive as to what work they will have to do on any particular locomotive. Special work that relates to the handling of the power may then be discussed between the gang leaders and foreman and plans made according to the needs of the service, i.e., whether to work on this or that locomotive in preference to another, how much of the work is to be done at the time and what work to leave until the locomotive returns from another trip. In this way much valuable time is saved.

Where engine house or stall room is limited, locomotives sometimes accumulate between the coal wharf and the turntable awaiting their turn to get into the house. While this cannot always be avoided, advantage may be taken of the time locomotives are lying there to test stay bolts, calk flues or do some work that does not involve pit work or jacking up. In some cases new fires may be built before placing the locomotives in the house.

In the engine house it has been found that by increasing the number of gang leaders so that each one will not have more than eight or ten men in his charge, and holding the gang leaders responsible for the quality of the work done by the men, much time has been saved, not only in getting the locomotives over the road but in future repairs as repairs having once been properly made last longer than those that are made indifferently. Another thing that means the saving of considerable time eventually, while extending it at one particular handling, is that of requiring a special and very thorough examination by one or the other of the gang leaders at the boiler wash or test periods. At this time all parts, the condition of which is controlled by tolerances, are checked up and various other parts of the machinery and appliances are examined in conformance with a standard list prepared for the purpose and the condition noted on a form. The object of this is to renew or repair all parts that do not appear to be in a condition to last until the next boiler wash day arrives. In other words, the time that the locomotive must lie up for boiler wash is taken advantage of in using every known means to put the locomotives in such shape that they will stay in service with a minimum amount of repairs until the following boiler wash day. As we are fortunate in having to wash boilers only once in four weeks it will be seen this method of inspection and repairs will save time in the end.

A pit in the storage yard to enable the sponging of boxes and other light work is of great assistance in reducing the time of handling locomotives, for by this means some locomotives may go directly to it from the ash pits and others may be moved from the engine house to be finished there, thereby making room in the house for another locomotive sooner than otherwise would be the case.

While it is undesirable to get up steam too rapidly, time in the preparation of new fires may be saved by the use of shavings soaked in crude oil. Two buckets full of shavings and six pounds of oil are sufficient for the largest fireboxes, but the operation may be hastened if desired by slightly increasing both.

Machinists and their helpers as well as air brake men both day and night working piece work materially affects the time locomotives are undergoing repairs. The matter of tools and machinery is most important. Every engine house should be equipped with enough hand tools from jacks to wrenches so that there will be no waiting by any of the mechanics for this or that tool. A well arranged tool room, ample in size and kept in an orderly condition by an efficient man who is capable of making necessary repairs to all ordinary tools, cannot fail to have a beneficial effect on the quick handling of locomotives while undergoing repairs. Special appliances for hastening the work of repairs are a necessity. There should not be a lack of the machines necessary to make the parts of locomotives that must be repaired in the machine shop as this will cause a loss of time. By having a blacksmith and helper on duty at night, hours may be saved by avoiding the delay incident to waiting for the day men to come to work.

No matter what the facilities are for handling locomotives the best results will not be obtained from them without the aid of a good live foreman who is tireless in getting after the lost motion and reducing it, for it is the lost motion, particularly between the various operations, that swells the total time of handling.

The yard master may assist materially in preventing congestion and consequent lengthened time in handling by sending his shifting locomotives to the engine house singly instead of a number at the same time, and were he to take so much interest as to consult the foreman as to the latter's convenience and if necessary retard the movement towards the engine house of the shifting locomotives, that would be co-operation indeed and it would be productive of very good results.

When the locomotives have been placed in the storage yard and marked ready for service it only remains for the engine house people either to maintain banked fires or fires in such shape that a full pressure of steam may quickly be raised, depending on the time for which the locomotives are ordered; in this way coal may be saved in one case and in the other case time may be saved when the crew reports for duty.

The time of preparation by the engineman is considerably reduced by having a man in the storage yard to fill the lubricators and grease cups on locomotives equipped with the latter. The same man also may give a final inspection to see that no work has been left undone, thus saving the annoyance and delay in making repairs when the locomotive is otherwise ready to leave.

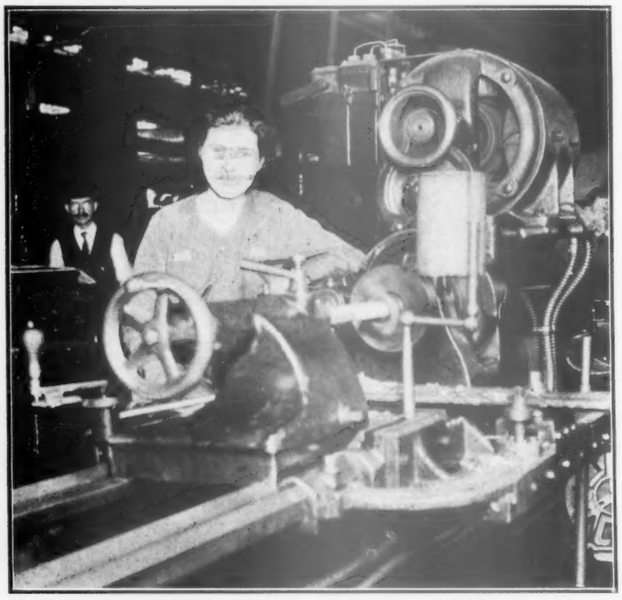
The final terminal delays are strictly up to the operating department and the responsibility lies between the trainmasters and yard masters.

If after doing everything that lies in his power to get locomotives ready for service as quickly as possible the engine house foreman sees them standing for hours on his storage tracks he may question the necessity of his hustling quite so hard and perhaps slack up a trifle, but a good foreman will not do this because he will realize that by maintaining the highest degree of efficiency at the engine house he is providing the operating department with the means in the shortest possible time for moving the vast amount of freight and incidentally place the other fellow in the awkward position of responding to the "Why?" thus lightening his own burdens to such an extent that he will have yet more time to devote to still greater achievements in the way of reducing the time of handling locomotives at the engine house.

WOMEN WORKERS IN RAILROAD SHOPS

Serious Labor Conditions Are Leading the Railroads to Employ Women for Many Classes of Work

THE depletion of the forces of the railroad shops of this country, which during the past year has been very serious, seems now to have reached a point where any further reduction will inevitably result in a loss of efficiency in that department of the railroad organization. It was thought by many that after the men who were chosen for the National Army were called there would be few changes in the force, but this has not been the case. The railway regiments now being formed for the purpose of rehabilitating the Trans-Siberian railroad will of course take their quota from the railroad shops, and the increasing requirements of other branches of the Government service will result in the withdrawal of considerable numbers. Of greater consequence, however, is the readjustment of labor, which will proceed slowly for a considerable period. Many of the war industries have lost men through the selective draft, and a part of the positions thus made vacant will surely be filled from the ranks of railroad shopmen, some of whom place the higher wages to be secured elsewhere above the permanence of employment which the railroads provide.



An Expert Machine Operator Who Was Formerly a School Teacher

It is quite unnecessary to state that no curtailing of the output of the railroad shops can be permitted at this time. In spite of all that the railroads can do, cars and locomotives will deteriorate faster than they can be repaired. Daniel Willard, in his address on "Railway Efficiency and the War,"* made it clear that the efficiency of the railroads will play an important part in winning the struggle. To keep the equipment of the railroads of this country in condition has now become a patriotic duty.

How is the labor situation to be met? In spite of the numerous wage increases which the roads have put into effect since the beginning of the war, it is impossible for them to compete in the labor market with plants manufacturing war supplies. Even if it were possible to put wages on a plane that would draw men from other industries, many would be taken from shops whose work is essential at this time, and the nation's productivity would not be increased by the shifting of workers. Labor-saving machinery might help the situation in some cases, but it is almost impossible to secure tools at this time, owing to the unprecedented demand. The logical way out of the difficulty seems to be to employ women in greater numbers for doing work in the shops.

Many roads have introduced women workers in the mechanical department, among them being the Baltimore & Ohio, the Erie, the New York Central Lines, the Minneapolis, St. Paul & Sault Ste. Marie, the Chicago, Burlington & Quincy, the Northern Pacific, the Union Pacific, the Oregon Short Line and the Chicago, Milwaukee & St. Paul. On most of these roads the employment of women has passed the experimental stage, and sufficient data are now available to make it possible to judge the value of women in shop work. Some observations made in shops where women have been employed for some time will show the progress that has been made in this direction.

The difficulties encountered in introducing women workers in the shops have not proved serious. Rooms in which women can change from street to shop clothes, rest rooms and toilet facilities are, however, essential. Where women are employed around shops, skirts are in most cases a hindrance and sometimes a source of danger. It is, as a rule, unnecessary to urge the adoption of more suitable attire, the women workers being quite willing to don loose overalls. Women who work around power-driven machines should wear caps, to preclude the possibility of injury by loose strands of hair catching in shafting or belting. In many states the hours of labor of women workers are limited by statute and special reports are sometimes required, but these are of such a character as to require but little clerical work.

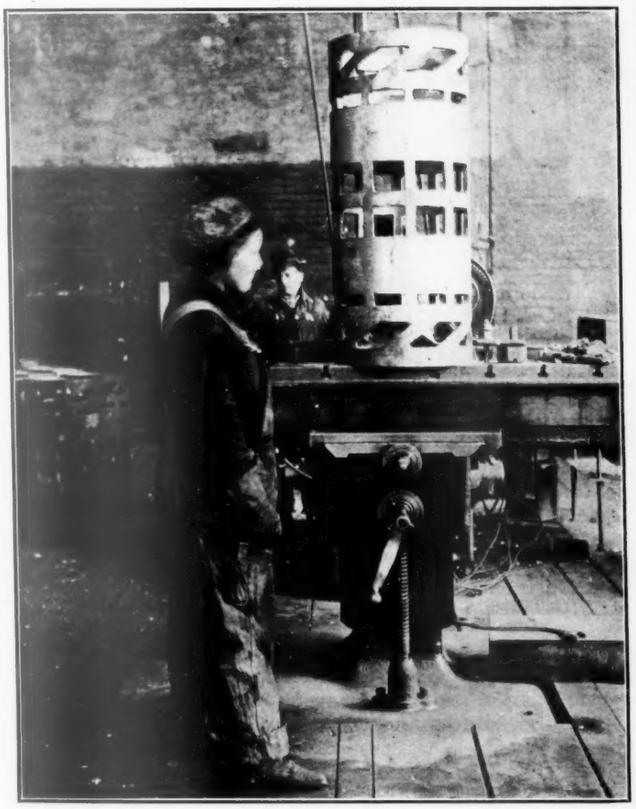
Women Cleaning Locomotive Cabs at the Pocatello Roundhouse, Oregon Short Line

On many railroads women have heretofore been excluded from the shops to such an extent that it is an easy matter to find positions, for which women are quite as well fitted,

*See *Railway Mechanical Engineer* for September, 1917, page 489.

now filled by men. For example, there are a great many male clerks employed in places where women, after a short period of training, could handle the work with little difficulty. At the Havelock, Neb., shops of the Chicago, Burlington & Quincy a woman is employed in distributing blueprints with entire success, although the work requires some knowledge of locomotive parts in addition to an understanding of the filing system. At Havelock women are also doing work which requires considerable skill, such as operating lathes, milling machines, gear cutters and shapers. Their work has been found highly satisfactory, and, though a trifle slower than men, they seldom make mistakes and do very accurate work.

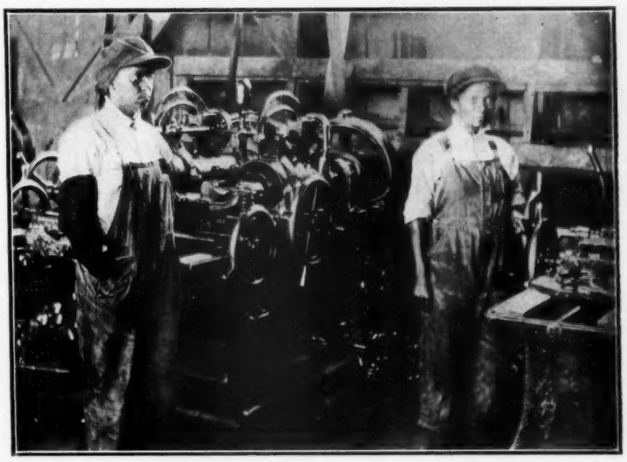
An instance which shows the natural adaptability for machine work that some women display will serve to indicate the possibilities for women in railroad shop work. A young lady who, after graduating from a university, had been



A Woman Operator at the Pocatello Shops of the Oregon Short Line Milling the Ports in a Valve Chamber Bushing

teaching the sciences in a Nebraska high school, secured a position in the Havelock shops of the C., B. & Q., thinking the experience she could gain during the summer would be of value to her in teaching. She became so proficient that she was assigned to lathe work in the tool room, and the work proved so fascinating that she resigned from her teaching position. Although the lady in question had intended to remain in the shops indefinitely, her stay there was limited to three months. At the end of that time a vacancy occurred in the general offices of the mechanical department, for which she was particularly qualified by reason of her shop experience, and she is now holding a responsible position in the offices of the general superintendent of motive power.

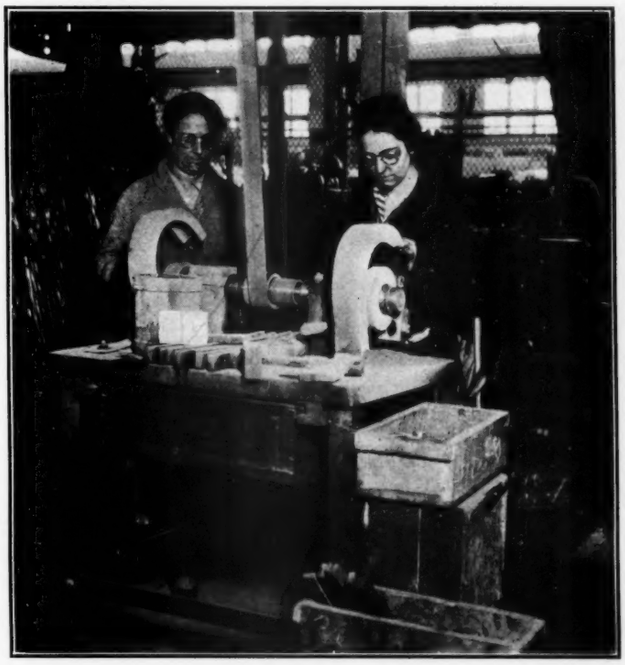
At the Pocatello, Idaho, shops of the Oregon Short Line women are now handling a large part of the work in the machine shop and car department on which male help was previously used. Women are probably employed to a greater extent in this shop than in any other in this country. The effort to relieve the labor situation in the shops in this way has been so successful that probably if it were possible to get more women for shop work they would be employed in even greater numbers. No special training was provided for



Colored Women Working on Bolt Cutters at Pocatello Prove as Efficient as Men

the women workers except such as is usually given to apprentices. The instructor who directed the work of the apprentices also instructed the women. All the women at Pocatello are under the supervision of men, but at Salt Lake, on the same road, where a great many women are employed as coach cleaners, a woman is in charge, who reports to the foreman of the coach department.

In the machine shop women are employed in the operation



Women Employees Grinding Tools at the Havelock Shops of the C. B. & Q.

of engine lathes, boring mills, milling machines, planers, brass lathes, drill presses, cutting-off machines and nut-tapping machines. Most of the women are kept on specialized work. Those who show special adaptability, however, are

trained on machines of all kinds, and some are capable of running almost any machine in the shop. It is the opinion of those in charge that a considerable proportion of the women workers could readily be developed into skilled machine operators.

The reclaiming and repairing of cab cocks, globe valves, boiler checks and miscellaneous valves is now done largely by women. In the tin shop they are repairing lanterns, oil cans, etc., as well as doing general tinsmith work. A woman is employed to run the motor-driven transfer table. Staybolts are finished in the boiler shop by two women, who are doing as good work as the men who formerly ran the machines. All parts of locomotives are now painted by women.

In the coach shop women are doing the upholstering, cleaning coaches and preparing them for painting. Two colored women work almost entirely at painting and varnishing coach sash. While men are still employed on engine wiping, cabs and windows are cleaned by colored women.

It has been found that the output of the women workers employed at Pocatello compares very favorably with the output of male help, and, with efficient supervision, the quality of the work is equally good.

At other shops women are employed on various classes of work which have not been mentioned, acting as helpers for machinists, blacksmiths and car repairers, operating steam hammers, building grain doors, packing journal boxes, reclaiming waste, sorting scrap and cleaning yards and shops.

At least one road has employed women as tracers in the drafting room, which suggests a method for relieving to some extent the serious shortage of draftsmen. In general, the experience which the railroads have had with the employment of women in the shops seems to indicate that it offers in many cases the only satisfactory solution of the labor problem of the mechanical department.

LUBRICATION OF AIR COMPRESSORS*

A Discussion of Problems Encountered in This Work and of the Characteristics of the Oil to Be Used

BY THE LUBRICATION ENGINEERS' ASSOCIATION OF THE TEXAS COMPANY†

THE compression of air results in the conversion of the energy used into heat. The rise of temperature of a volume of air under compression follows certain laws, and tables have been compiled which show the theoretical temperatures the air will attain when compressed to certain pressures. The following table gives the temperature that air will attain taking the inlet at 60 deg. F.

Gage Pressure	Atmospheres	Final Temperature
0 lb.	1.	60 Deg. F.
25 lb.	2.7	234 Deg. F.
50 lb.	4.4	339 Deg. F.
75 lb.	6.1	420 Deg. F.
100 lb.	7.8	485 Deg. F.
125 lb.	9.5	540 Deg. F.
150 lb.	11.2	589 Deg. F.
200 lb.	14.6	672 Deg. F.

In actual practice, however, the temperatures never reach these figures, for the reason that in the economical operation of compressors it is very important that the temperatures be kept as low as possible. For this reason the compressor cylinders and cylinder heads are provided with jackets through which cold water is circulated to absorb as much of the heat of compression as possible. A large percentage of the trouble experienced with air compressors is on single stage compressors. Examinations have shown that in many instances this is due to the fact that they are overloaded from being forced beyond their capacity, excessive heat being generated thereby.

Where the air is compressed through more than one cylinder, the temperature of the air is still further reduced by passing it through intercoolers on its way from one cylinder to another. The water side of intercoolers and water jackets should be kept free from all dirt, mud, and other foreign matter, which the cooling water is apt to bring with it. This foreign substance can be detected by watching the discharge from the jackets or coolers. The failure to observe this precaution has in some cases been responsible for air compressor explosions as jackets and coolers become very inefficient if they are coated with mud or scale.

EXTERNAL LUBRICATION

The external lubrication of air compressors does not differ from ordinary external lubrication. In the case of steam driven compressors the main bearings, crank pins, cross-head pins, and cross-head guides are usually lubricated by a splash system. In some cases the crank pins are fitted with pendulum oilers with stationary cups, and the other bearings are fitted with sight feed oil cups.

In design and construction the air compressors of the ordinary or piston type is similar to a steam engine. The action, however, is the reverse of the steam engine, for in the case of the air compressor cylinder, power is transmitted to the piston through the shaft and connecting rod, instead of from it.

INTERNAL LUBRICATION

So far as internal lubrication is concerned, the problems offered by the steam engine and the air compressor cylinder are entirely different. In the steam engine, moisture, which has a tendency to wash the oil from the surfaces of the cylinder and valves, is always present to a greater or less degree, requiring in most cases, the use of a compounded oil. In air compressor cylinders, on the other hand, the surfaces are dry, and so compounded oils are never used. Moreover, less oil is required for the air compressor cylinders, since the oil is not washed off the cylinder walls.

As in the case of steam cylinder lubrication, the conditions of the internal surfaces, the piston speed, and the weight and fit of the piston must be taken into consideration in selecting the proper air compressor oil. Low speeds and heavy or loose fitting pistons require a higher viscosity oil than high speeds and light or tight fitting pistons. Other important factors which govern the lubrication of air compressors are the degree to which the air is to be compressed, the location of the air inlet, the method of applying the lubricants, the kind of valves used, and the size and kind of water jackets and intercoolers.

In the horizontal air compressor, as in the horizontal steam engine, the entire weight of the compressor piston must be sustained by the lower portion of the compressor cylinder. With this type of compressor it is, therefore, necessary to use a lubricant of sufficient body under the heat of

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† Papers on this subject were submitted by the following members of the association: Messrs. W. M. Davis, Douglas L. Keys, W. A. Edmundson, H. K. Eilers, J. N. Prewitt, H. J. Wilson, Howard Cooper, John H. Young, Jr., F. A. Neale, H. W. Salbador, H. B. Joseph, J. T. Snow, C. M. Roe, A. Nielson, W. A. Ludwick, J. D. Barton, C. H. Kennerly and J. W. McGuire.

compression to prevent metal contact, and to reduce wear to a minimum. Vertical compressors do not require as much lubricant or as heavy a lubricant as horizontal compressors.

CHARACTERISTICS OF THE LUBRICANT

One of the most important requirements of an air compressor oil is that it should have a viscosity sufficiently high to meet service requirements. For high pressures and temperatures an extra heavy viscosity oil should be used. For medium pressures and temperatures a heavy viscosity oil should be used, and for low pressures and temperatures a medium, and in some cases, a light viscosity oil should be used. The oil should have sufficient body to sustain the weight of the moving parts, to form a seal between the piston rings and the cylinder walls, and to prevent the excessive use of oil. On the other hand, the viscosity should not be too high to obtain efficient atomization or to cause excessive friction. Moreover, if an oil of too great viscosity is used, it will tend to collect any dust that may be in the air and will tend to bake on the hot surfaces and form carbon deposits. This is especially likely to happen when more oil has been used than is just sufficient to lubricate the wearing surfaces.

Another requirement of air compressor oil is that it should not be decomposed under the heat conditions to which it is subjected in the air compressor cylinder, resulting in the formation of carbon. The chief objection to steam cylinder stocks is that they easily decompose under air compressor cylinder conditions, forming sticky and hard carbon deposits in the cylinders and valves or air lines. Carbon deposits are probably the chief cause of air compressor explosions. They also hinder the working of the valves and by increasing the friction cause an increase in the temperature of the air. Carbon also has a tendency to cause bad cutting of the valves and valve seats, which can result in a considerable amount of damage in a short time.

An extremely high flash test has been greatly over-emphasized as a qualification for air compressor oils. Even though the temperature of compression should reach the flash point of the oil an explosion would not take place, as the flash point is considerably increased by the high pressure and as a spark or flame must be introduced before the oil would flash. If carbon deposit is present, which is rendered incandescent by the increased heat of compression, an explosion may occur irrespective of the flash of the oil. The oil would have to be submitted to a temperature much higher than its flash point before combustion would take place without the introduction of a spark or flame. A good example of combustion without the introduction of a flame is that of the Diesel engine in which the temperature is as high as 1,000 deg. F.

One of the troubles commonly met with in compressors is the groaning of the pistons. Generally this can be traced to an improper fitting of the piston rings, which, being subjected to alternating pressure, set up a vibration which allows the air under compression to leak by the piston rings in an unsteady flow. This in turn, increases the vibration of the rings and results in the groaning of the pistons. This condition exists in compressors that have been in use for a considerable time without renewal of rings, and it can frequently be overcome by using a higher viscosity oil.

METHOD OF APPLYING THE OIL

In steam cylinder lubrication it is necessary that the oil be atomized or broken up into small particles so that it will be carried by the steam to the surfaces to be lubricated, as well as to the exhaust valves. The same is true, to a certain extent, in air compressor lubrication, in which case the oil should be atomized by the incoming air, and carried to the surfaces of the cylinder walls and to the exhaust valves. As in the case of steam cylinder lubrication, the atomization becomes more complete with an increase in distance between the point of introduction of the oil and the valve chest.

Ordinarily the oil is introduced into the air compressor at or above the point of air intake. The greatest efficiency is obtained by the use of automatic lubricators, and many types of compressors are now equipped with these lubricators. In many cases of steam driven compressors two-compartment lubricators are used for feeding two kinds of oil, one to the steam cylinders and the second to the air compressor cylinders. These lubricators insure a uniform rate of feed irrespective of any changes in the air pressure.

AMOUNT OF OIL TO BE USED

It is impossible to make any hard and fast rule as to the proper amount of oil to use in a compressor. Trouble experienced with air compressors is probably more frequently due to the use of an excessive amount of oil than to any other cause. The amount of oil necessary to lubricate an air cylinder is usually about one-third or one-fourth the quantity required to lubricate a steam cylinder of the same size. If the lubricant is unsuitable, an excessive amount is required to keep the cylinders from groaning, and the result of the use of an excessive amount of oil is carbonization. in the air passages, and particularly on the discharge valves. Sticking of these valves, allowing hot compressed air to flow back into the compressor cylinder, is a sign of too much oil. The discharge valves should be examined regularly, and the receiver and discharge pipes blown out. This will effectually remove all oil, water, and sediment, which may have accumulated. The trouble sometimes experienced in the lubrication of the high pressure cylinder of a three stage compressor can usually be attributed to excessive amounts of oil.

Another cause of complaint has been found to be due to the use of unsuitable oils, such as compounded steam cylinder oil, in the air compressor. These oils, besides being very viscid, contain much free carbon matter, which clings to the orifices of the discharge valves and seats gathering dirt from the air. Under the influence of the dry heat together with the dirt from the air, these oils soon become carbonized and form a hard flinty substance that requires considerable labor for its removal, while the animal oil used in compounding separates and forms a sticky residue, which under the dry heat conditions decomposes, liberating a free fatty acid. This will honeycomb or etch the cylinder and piston surfaces and also make the piston rings more brittle.

SIMPLE METHOD FOR TESTING OILS

One of the engineers reports a series of tests which he conducted to determine the effect that heat would have on various lubricating oils when subjected to high temperatures such as exist in an air compressor cylinder. He took a block of cast iron about 6 or 8 in. square and 2 in. thick and placed it on a layer of dry sand in a shallow iron pan, packing the sand close around the cast iron block, and placed the pan over a gas burner. The upper surface of the block was polished and a hole about ½ in. deep drilled in it, large enough to hold the mercury bulb of a thermometer, cylinder oil being poured into the hole so as to make a close heat contact.

Air, taken at a temperature of 60 deg. F. and compressed to 125 lbs. per sq. in. gage pressure, will theoretically attain a temperature of 540 deg. F., but in actual practice, owing to the water flowing through the heads and around the cylinders, the temperature of the discharged air seldom, if ever, goes above 400 deg. in a single cylinder compressor, so the block was heated to this temperature.

When the thermometer showed 400 deg. F. a certain oil was taken that had been used at one compressor plant. This was a very light bodied, paraffine base oil, about like a spindle or ice machine oil. A drop of this oil was allowed to

fall from the point of a lead pencil from a height of 2 in. onto the block. In ten seconds it had spread out to a circle of 1⅛ in., smoked slightly, and dried up almost instantly, thus indicating that it was a very poor compressor lubricant.

Then a drop of a slightly heavier oil, such as would be suitable for use in turbine and motor bearings, was tried. This spread out quickly to a diameter of 1½ in., smoked slightly and dried up in two minutes. It was but little better than the first oil.

A still more viscid oil, about like a medium bodied engine and machine oil, was then dropped on the hot surface. It spread out slowly to a diameter of 1¼ in., smoked slightly, and the surface was oily after five minutes. In the meantime the temperature, as shown by the thermometer, had gone up to 420 deg. F.

A still heavier oil, such as is usually used in gas engines, did still better, even after the temperature had gone up to 450 deg. F. It smoked but little, and a good trace of oil was still on the block after ten minutes.

A steam cylinder oil was then tried. It did not smoke or dry up, but after a while it became thick and gummy.

Even at the highest temperatures the engine oils burned up clean, leaving no trace of dry coke or carbon matter, which tends to confirm the theory that the hard formation often found in and around the discharge valves of air compressors is due largely to the presence of dirt in the air which adheres to the oily surfaces and which, under the continuous dry heat, becomes baked and burnt on.

The deductions that may be drawn from these crude tests are that for such temperatures as would be encountered in a single stage compressor, compressing to 125 lb., a high grade filtered mineral oil of moderately high vaporizing point, suitable viscosity, and especially low in carbon content, will give best and most economical results. If such an oil is used in moderate amounts, if the cooling water is sufficient, if the water jackets of the cylinders and heads do not become choked with mud and sediment, and if the air inlet is properly located, no trouble will be experienced with lubrication.

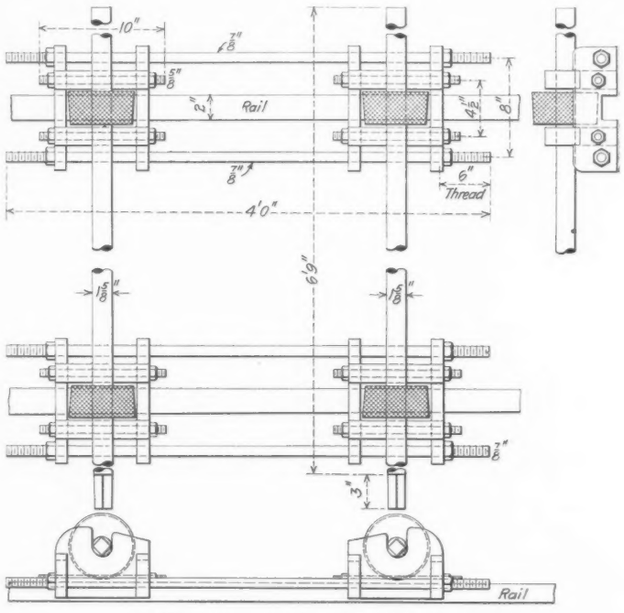
The location of the air inlet on an air compressor is of great importance, and extra care should be used in placing it at points where dust will not be collected.

AIR COMPRESSOR EXPLOSIONS

While air compressor explosions occur at rare intervals, the fact should be emphasized that properly operated and properly cared for compressors are as harmless as steam engines. The cause of isolated explosions is still a disputed matter, though some phases of the question are now generally agreed upon by engineers familiar with air compressor practice. In the first place, the theory that these explosions are due to the use of an oil with a comparatively low flash point is thoroughly discredited, as they occur more frequently where a high flash oil is used. In the second place, it is generally agreed that the explosion is due to the accumulation of carbon deposits in the air lines. This deposit in turn is caused either by the use of an unsuitable oil, which decomposes, or to the use of an excessive amount of oil, or to the improper location of the air inlet. The belief that the explosion is always produced by the ignition of a volatile mixture, usually of vaporized oil and air, though possibly of coal dust and air, in the air tanks or lines, is questionable in view of the fact that the small amount of oil volatilized in the air compressor cylinder would be insufficient to form an explosive mixture with the air, as this volatile matter is constantly being carried off with the air. It could only be in a case where a very excessive amount of oil was used or where pockets of oily residue were allowed to collect that a sufficient amount of vaporized oil could collect to form with the air an explosive mixture. Even in such a case the cause of the explosion would not be the vaporized oil but would be some other factor which produced a spark or flash. The probable source of this spark is again the carbon deposit, which may be responsible for a sufficient increase in temperature, by restricting the air passage and thus so increasing the pressure, as to cause the carbon to become an incandescent mass. It is not improbable that in some cases this glowing mass of carbon may weaken the tensile strength of the air receiver or the air lines to such an extent that they are no longer able to withstand the pressure of the air, the result being an explosion.

ROLLERS FOR APPLYING ECCENTRICS

On account of the small amount of clearance around the nuts on eccentrics the work of applying them, even with special wrenches, is usually not easy. To make it possible to get the eccentrics in the most advantageous position when ing the work, rollers on which the wheels are placed are used at the Dale Street shops of the Great Northern. The drawing



Light Rollers Used in the Wheel Shop

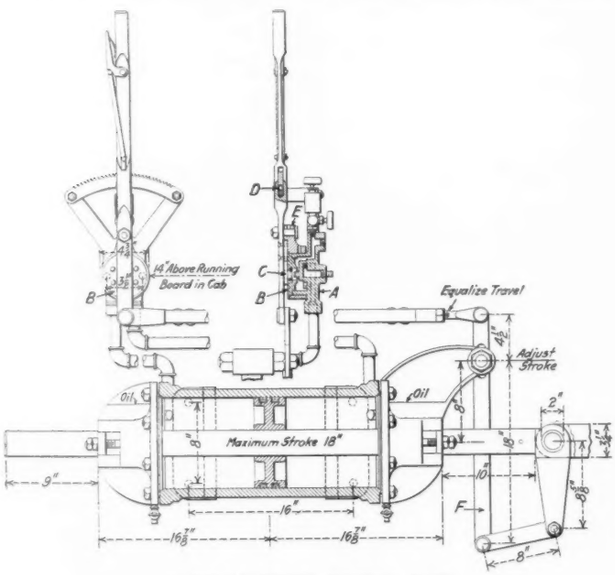
reproduced below will make clear the construction of the device. When in use it is set on the rails and adjusted to hold the wheels clear by a slight amount. The wheels are placed on the rollers and removed by a crane, although if necessary the device could be assembled in position and the wheels raised by screwing up the nuts on the ⅞-in. rods connecting the housings. The wheels are turned by a ratchet handle on the shaft of the driving rolls.

Record-Breaking Aeroplane Flights.—Lieutenant Resnati, an aviator of the Italian army who has been making experimental flights in this country, arrived at Mineola, L. I., 20 miles east of New York City, in 4 hrs. 11 min. from Hampton, Va., carrying eight men besides himself. The distance is about 320 miles, making the average rate of speed about 76 m. p. h. The machine, a tri-plane, with 85 ft. spread of planes, has three motors of 160 hp. each. Most of the journey was made at a height of about 9,000 ft., at which height the temperature most of the time was about 32 deg. F. On the same day Lieutenant Baldroli, also an Italian, made the same trip in a 210 hp. machine, carrying one passenger, in 2 hrs. 55 min., or at the rate of about 110 miles m. p. h. Passing over New York City, Lieutenant Resnati rose to a height of about 12,000 ft. for the purpose of avoiding disagreeable "air pockets."

LEWIS POWER REVERSE GEAR

The Lewis power reverse gear, which is shown in the illustration, is characterized by simplicity of construction and a high degree of adaptability, so far as its location on the locomotive is concerned. These qualities have been obtained by the location of the control valve in the cab, where it is directly connected to the reverse lever, and by dispensing with the crosshead and guidebar for the piston rod. This gear is the development of the Commonwealth Supply Company, Richmond, Va.

The attachment of the gear to the locomotive is effected

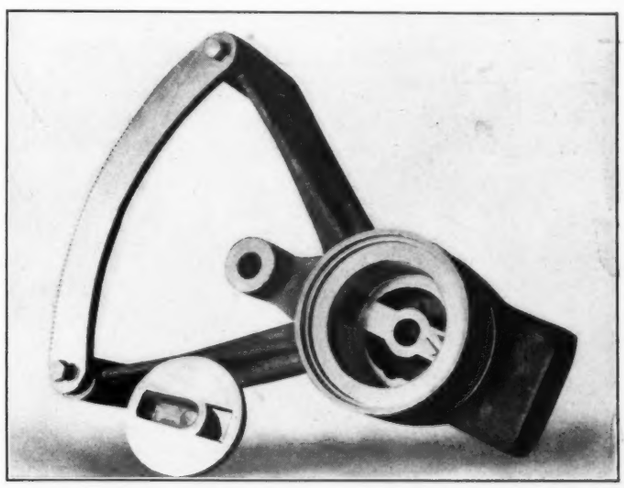


A Simple Power Reverse Gear

by means of brackets cast integral with the cylinder. Because of the absence of attachments for a guidebar or other parts of the gear, it is thus possible to bolt the gear directly to the under side of the running board, to brackets attached to the boiler or to the frame of the locomotive, as the requirements of each particular case may make most desirable. The cylinder is merely turned to bring the faces of the brackets in the desired plane, the cylinder and heads being assembled with the brackets at the top, sides or bottom, as the case may be. The drain cocks have been placed in the cylinder heads in order that there may be no need of drilling special holes in the cylinder for each method of attaching the gear to the locomotive.

The control valve is of the rotary type with the seat in a vertical plane. Air is admitted to the top of the valve at the valve housing *A* and is admitted to the cylinder ports by means of a port through the valve. The exhaust cavity in the face of the valve is always in communication with a port in the valve housing leading directly to the atmosphere. The valve is operated by means of a stem or port *C*, in the end of which is a slot fitting over a rectangular lug on the top of the valve, thus relieving the valve of any tendency to tilt due to improper alinement of the operating post. To the outer end of the post is keyed a short arm, in the upper end of which is a slot working over a hardened block on the reverse lever.

The reverse lever has no fixed pivot. The initial movement of the lever is pivoted about its lower end, where it is pinned to the back end of the reach rod. The extent of this movement is limited by a special tap bolt in the valve seat, the head of which extends up into the admission port in the valve and permits the valve to move in either direction only sufficiently to register with the admission ports in the valve seat. If the movement of the lever is forward, air is admitted to the rear end of the cylinder and immediately causes a forward movement of the piston. This is communicated to the lower end of the lever through the stroke lever *F* and the reach rod, and permits the continued movement of the upper end of the lever in a forward direction. During this part of the motion the lever is pivoted about the control valve



The Quadrant and Valve Housing with the Rotary Valve Removed

connection and is retained in its proper location relative to the quadrant by means of the reverse lever guide *E*. This guide is a sleeve mounted on the valve housing, about which it is free to revolve. When the desired movement of the reverse lever is completed and the lever latched, the latch on the quadrant becomes the fixed point in the further movement of the lever necessary to lap the valve.

The quadrant is notched for 30 cut-off positions each in forward and back motion, a very fine adjustment thus being provided. There is a spring latch *D* on the reverse lever

which operates underneath the quadrant to indicate when the lever is in central position. This assists the hostler in locating the exact center of the motion with certainty.

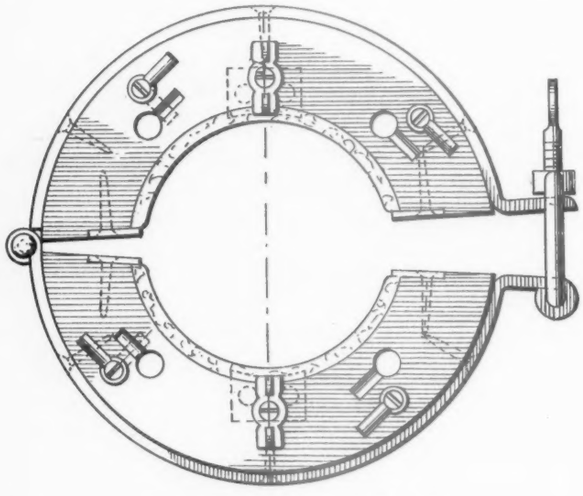
When there is no air pressure on the reverse gear, the lever can be moved only slightly; it is impossible for it to be thrown into one of the corner positions until air pressure is available to effect the movement of the link block to a corresponding position. This is the result of the limited movement of the rotary valve. After the side of the valve admission port comes in contact with the head of the tap bolt projecting up from the seat of the valve the further movement of the reverse lever is dependent entirely upon the movement of the piston.

One of the unique features of this reverse gear is the ease with which the length of the piston stroke may be adjusted without blocking off the corners of the quadrant. There is a vertical slot in the stroke lever *F* where it is pivoted to the front cylinder head. The end of the pivot pin extends through this slot in which it is secured by two nuts, one on either side of the lever. An adjusting screw, the length of which is equal to that of the slot in the stroke lever, is threaded through the pivot pin, and by means of this screw the position of the pivot pin in the slot is determined. It is possible with this arrangement to vary the relative lengths of the two arms of the stroke lever by an amount sufficient to change the length of the stroke from 18 in., which is its maximum, to 15 in., without affecting the movement of the reverse lever on the quadrant.

A crosshead and guide having been dispensed with, the piston rod is guided by means of long sleeve glands in both cylinder heads. These glands are bored to a running fit for the piston rod and are of sufficient length to provide the necessary bearing area. The glands are adjusted against the packing in the usual manner. The cylinder heads are cast with large oil pockets which communicate with gutters milled in the piston rod glands for lubricating the piston rod packing and gland bearings. The lubrication of the control valve in the cylinder is cared for in the cab, the lubricator being attached directly to the valve housing *A*.

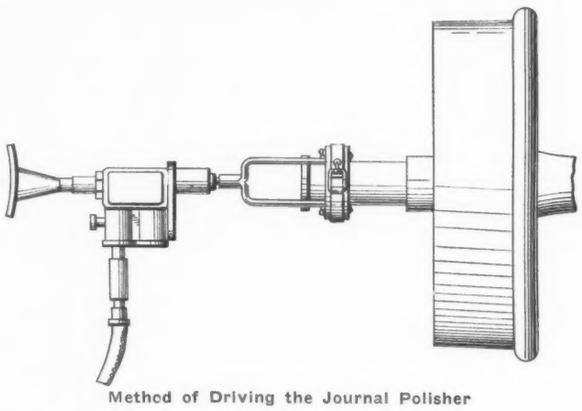
JOURNAL POLISHER

A method for providing a smooth surface on car journals has been developed and patented by W. H. Basenberg of Birmingham, Ala. It consists of a band of leather attached



Clamp for the Journal Polisher

to clamps as shown in the illustration, which, when revolved on the journal surface, will give a polished finish. A mixture of emery and oil is used as the polishing mixture. The apparatus after being applied and clamped to the journal is rotated by an air motor as shown in the illustration. The purpose of this device is to provide a smooth surface on the

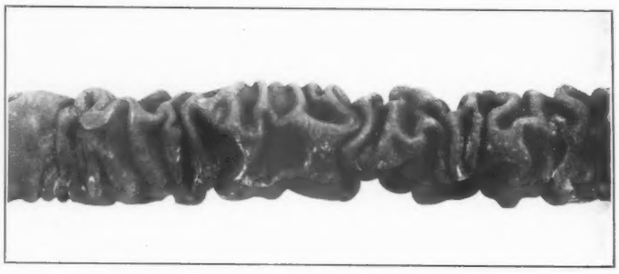


Method of Driving the Journal Polisher

journal which will reduce friction. The size of the journals is accommodated by the various thicknesses of leather used in the clamp.

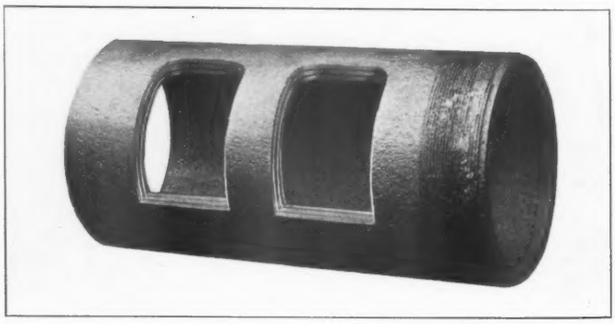
A DEMONSTRATION OF THE DUCTILITY OF STEEL PIPE

Static tests of material, upon which dependence has long been placed as a means of learning what actually may be expected of the material in service, are of the highest value



Portion of an 18-ft. Length of Steel Pipe Which Crushed to a Length of Six Feet Without Failure

to the engineer. Graphically, however, they fall far short of the conditions often arising in service as a means of demonstrating the physical characteristics of material. The



Three Sections of 8¼-in. Welded Steel Pipe Telescoped Without Failure

photographs here reproduced do not show the results of laboratory tests and, indeed, the conditions under which the results shown were obtained could hardly be reproduced in the laboratory.

The crumpled piece of pipe shown in one of the illustra-

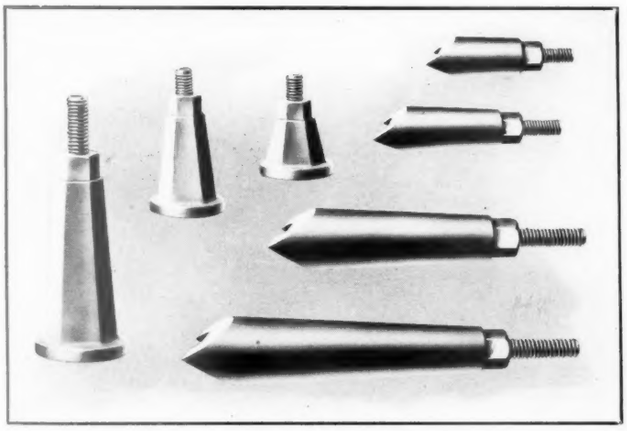
tions is a part of a section of National Tube Company's steel oil well casing 5 3/16 in. in diameter, the original length of which was 18 ft. This pipe became stuck in the well and an attempt was made to blow it out by the discharge of 170 quarts of nitro-glycerine, it being the purpose at the same time to "shoot" the well. The pipe, however, instead of being blown out of the well, was reduced in length from about 18 ft. to approximately 6 ft. and with considerable difficulty was removed from the well in the condition illustrated. There was no evidence of fracture in any part of this piece of pipe.

The second illustration shows the remarkable result of another oil well accident. In this case a string of casing pipe 8¼ in. in diameter, about 1,440 ft. long and weighing over 34,000 lb., was dropped for a distance of 200 ft. to a limestone bottom. The force of the blow caused the three bottom sections to telescope, one inside the other, as shown where a portion of the pipe has been cut away. This was National welded steel pipe and the three lengths telescoped as shown without any evidence of cracks or failure in the welds.

JACKS WITH NON-REVOLVING SCREWS

In the usual type of screw jack or clamp, the movement of the screw is effected by revolving it in the nut, which is an integral part of the jack body. This necessitates the use of a swivel cap on the end of the screw in order that there may be a stationary bearing against the load. There are several obvious objections to this arrangement which materially limit the range of usefulness of screw jacks.

A type of jack construction has been developed by the

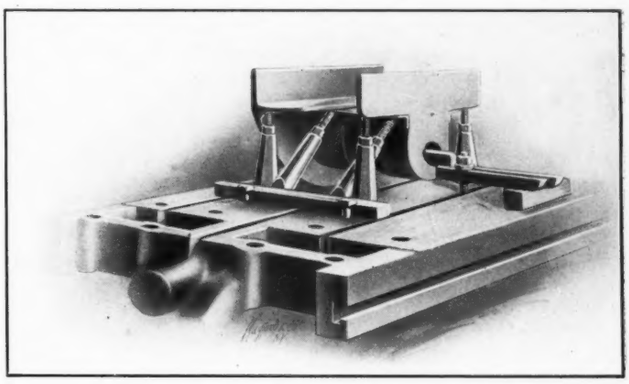


Machinists' Jacks with Non-Revolving Screws

Bradney Machine Co., Inc., Middletown, N. Y., which is designed to overcome these objections to the ordinary type of screw jack. In this construction, which is known as the Bradney-Priester jack screw, the only movement of the screw itself is in line with its own axis. The nut is separate from the body of the jack and revolves on a bearing at the top of the body. Patents have been applied for on this principle of construction.

In the first illustration are shown two types of machinists' jacks for use in "set-ups" on planers, shapers, milling machines, boring mill tables, heavy drill presses, etc., for all classes of work where quick and rigid setting is desirable. As the only revolving part of these jacks is the nut no swivel head is necessary, and the end of the screws are provided with cup, conical or dog points, as the work may require. These points are set up directly against the work, where they maintain a tight grip with no danger of slipping or loosening under heavy strain.

In one of the illustrations the use of these jacks is shown in the set-up of a planer job. The casting to be planed is held down by two clamps only and all other strains are taken by the jack. It will be noted that the vertical jack at the left is set against a fillet in the casting, where it has a grip which becomes more secure the harder the screw is set up. The time required for making this setting and starting the cut is less than 15 minutes. With a suitable selection of sizes of jacks with the two styles of base shown, the use of more or less expensive special fixtures, adapted only to one class of work, may be avoided. Equally good results

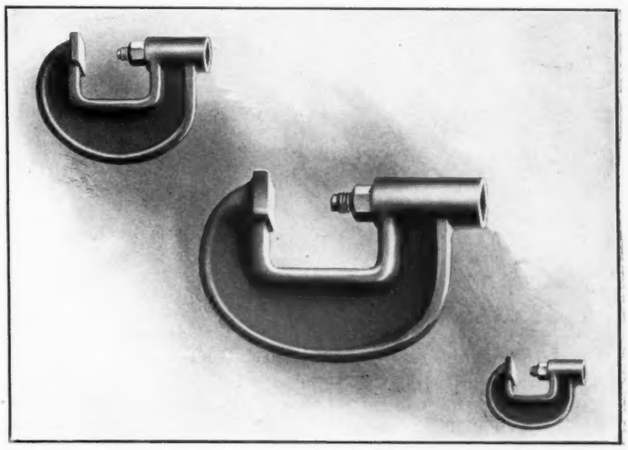


A Planer Set-Up with the Machinists' Jacks

may be obtained by the use of the jacks, which are available for a wide range of work.

The principle of operation of the "C" clamps is exactly the same as that of the machinists' jacks. Its advantage is obvious in that the difficulty usually encountered in clamping sloping or irregular surfaces, because of the tendency of the screw to creep and to cause a shifting of the work, is overcome by the positive, stationary grip of the end of the screw.

There are a number of advantages in the Bradney-Priester lifting jacks not possessed by the usual type of screw jack.



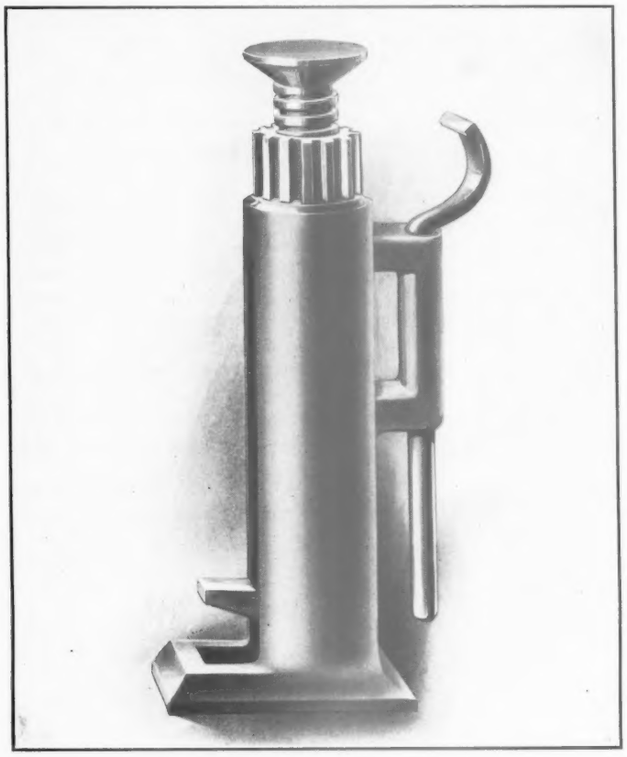
"C" Clamps of the Bradney-Priester Type

It will be noticed that the ram head is solid; it is unnecessary to provide a swivel head which is a source of considerable friction and excessive wear because it is subjected to the action of sand and dirt. In the old style jack screw the operating lever is inserted in a hole directly through the body of the screw and a working space of something over 90 deg. is required in order that the lever may be operated. As the nut is the revolving member in the new jack, it has been possible to provide the circumference of the nut with notches

for the use of a special spanner wrench, thus making the operation of the jack possible with a clear space for the wrench of but little more than 18 deg. As the nut revolves, it remains seated on the top of the jack and the load is therefore constantly moving away from the operating lever. With the old style jacks the operator may be given considerable annoyance and is often injured through lack of proper clearance for his fingers. Where this condition exists it remains constant throughout the lift.

Accidents have often happened with the usual type of screw jack because of carelessness of the operator in turning the screw completely out of the base. In the new jacks the screw cannot possibly be raised out of the body while lifting a load. At other times, however, the ram may be removed without delay by taking out a locking pin. The provision of a hole through the handle on the body of the jack, in which the operating lever may be placed, affords a convenient means of insuring against its misplacement or possible loss.

In all forms of this equipment the body of the jack is relieved from wear. The parts subject to deterioration from



The Bradney-Priester Jack Screw

wear are the nut and the screw, both of which may readily be replaced. As shown in the illustrations, the machinists' jacks are made with bases of two types. Those for vertical use are made in four sizes, ranging from 2¾ in. to 8¾ in., minimum height and 4 in. to 15 in., maximum height. The wedge-base bracing jacks have a range of 3¾ in. to 8¾ in. minimum length in four sizes and a corresponding range of 6 in. to 16 in. in maximum length. There are five sizes of clamps ranging in depth of throat from 1½ in. to 5 in. The clamps have malleable iron bodies, but may be furnished in cast steel if desired, and in form to meet the requirements of special work. The regular sizes of the lifting jacks range in capacity from 10 to 36 tons and special sizes may be provided up to 50 tons. The minimum height of the jacks varies from 8 in. to 24 in. through a wide range of capacity and height combinations.

TESTS OF MOORE HEATER CAR

The Underwriters' Laboratories recently conducted a test of a Moore heater car to determine the fire hazard involved in the use of this heating system. As a result of these trials the use of the car has been approved by the underwriters.

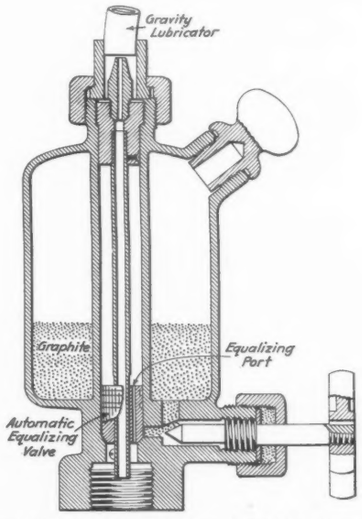
In the tests a complete heater was set up at the laboratory. The size of the car was reduced to obtain conditions less favorable than those found in the ordinary installation. The effect of the movement of the air when the car is in motion was secured by a blower, the velocity of the wind being varied and the action of the heater resulting from varying velocities noted. Records of the temperatures secured were taken from various thermometers placed about the heater and the car.

In the first test, which was conducted with the ventilator door wide open, starting from a temperature of 52 deg. F., the fire was forced until the temperature at the hottest point, directly above the hot air inlet into the car, rose to 428 deg. F. In the second test the vent door was closed and the fire was again forced. Above the hot air inlet the temperature rose to 410 deg. F., and in the heater box above the stove a temperature of 356 deg. F. was reached. Service conditions in a car in transit were duplicated as far as possible in the final test. The blower was operated, causing a wind velocity of 45 miles an hour perpendicular to the side of the car. Under these conditions the temperature above the hot air inlet rose to 440 deg. F. In another trial with the wind from the blower striking the car directly from the end, the highest temperature recorded was 370 deg. F. In none of these tests was any evidence of overheating or charring of the wood noted.

A Moore system heater car has also been examined and approved by the United States Bureau of Explosives. The Moore system is manufactured by the Refrigerator, Heater & Ventilator Car Company, St. Paul, Minn.

McCOY GRAPHITE LUBRICATOR

A device for feeding a mixture of graphite and oil to locomotive cylinders has been placed on the market by the Elijah McCoy Manufacturing Company, Detroit, Mich. The lubricator is attached at the top to the oil pipe from the



Sectional View of the McCoy Graphite Lubricator

gravity lubricator and at the bottom to the steam chest or steam pipe connection. The outer portion of the lubricator is a reservoir for holding the graphite and oil with a filling plug at the top and a feed valve at the bottom leading to a

passage through the center of the lubricator. In this passage is a stem, which is hollow to allow the passage of steam and oil from the gravity lubricator to the steam chest, the upper portion being fitted with a choke plug. On the lower end of the stem is a valve through which an equalizing port passes. When this valve is closed the feed of graphite is stopped, but when it is open, steam pressure flows into the reservoir and graphite is allowed to flow out. The valve is designed so that any fluctuation in the pressure in the steam chest will cause it to rise and fall on the stem, thus opening and closing the passage to the graphite chamber. Thus the graphite is fed to the cylinders whether the locomotive is running or drifting.

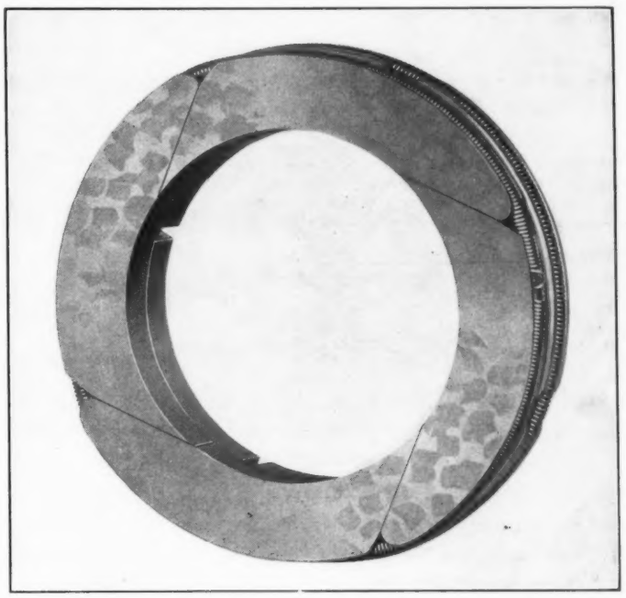
The lubricator requires but little care. It is filled with a mixture of graphite and engine oil by means of a squirt gun when in the roundhouse. The feed valve is then set and no more attention is required until the supply of graphite and oil is exhausted. In case of a failure of the gravity lubricator, it is claimed that a locomotive fitted with the graphite lubricator can proceed to the terminal without danger of failure. One filling of the lubricator is usually sufficient to supply the locomotive for a thousand miles. Several railroads are now using this lubricator and it is claimed that it has resulted in a material reduction in the consumption of valve oil and fuel.

CAST IRON PISTON ROD PACKING

A cast iron piston rod packing which has been used successfully in marine service has been developed for use on locomotives by the Martell Packings Company, Elyria, Ohio. This packing has been designated to meet the particular needs of superheater locomotives. It is made from a selected grade of cast iron and, as shown in the illustrations, consists of a pair of rings of four segments each, which are held in light contact with the rod by a coiled extension spring. This spring is made from a high grade of nickel steel which is not affected by the temperatures obtained on engines using superheated steam.

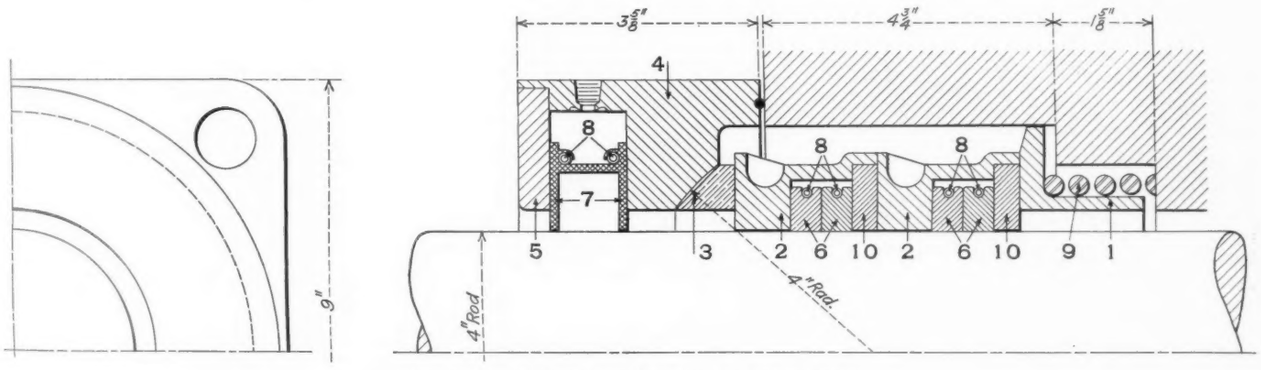
On marine work where engines run continuously for 12 to 18 days under high degree superheat, this packing has given particularly good results. On the Standard Oil steamer "Polarine" this type of packing was applied in the latter part of 1916 and has been in continuous service ever since with neither the piston rod or the packing rings showing any appreciable wear. In this particular case the boiler pressure carried was 180 lb. and the steam had a total temperature of 650 deg. in the high pressure cylinder. An average mileage of from 50,000 to 60,000 miles per set of rings have been obtained with trial installations on locomotives and in one particular case a mileage of 94,000 miles was made without a change, alteration or adjustment of the packing rings. In this case the diameter of the piston rod was reduced .006 in. during the time the locomotive made the 94,000 miles.

As shown in the drawing the packing is designed to float freely and easily with the lateral motion of the piston rod.



Cast Iron Packing Rings for Piston Rods of Superheater Locomotives

It is designed to prevent any abrasive substance lodging between the packing rings and the piston rod and the wearing parts can be placed without tools of any kind except for a wrench to loosen the gland. It can be applied quickly. The installation shown in the drawing has two sets of two rings each and is designed for a 4-in. piston rod.



Application of Cast Iron Packing to Piston Rods

1—Preventer
2—Floating Case
3—Ball Ring
4—Gland
5—Swab Retainer
6—Packing Rings
7—Swab Case
8—Packing Ring Springs
9—Spring
10—Backing Rings

ITALY'S COAL SHORTAGE.—Italy needs 800,000 tons of coal to run its railroads, munition factories and war industries. Italy's coal supply is so short that during the past summer more than one thousand square miles of forests were cut for use as firewood and in the preparation of charcoal. More than 500,000 tons of lignite was mined, both wood and lignite being used at present industrially, also on slow trains and switch locomotives. It is impossible to use such material for passenger trains, which have been under great pressure for months, due to military movements.

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WE GUARANTEE, that of this issue 9,000 copies were printed; that of these 9,000 copies 7,772 were mailed to regular paid subscribers, 122 were provided for counter and news companies' sales, 323 were mailed to advertisers, 215 were mailed to exchanges and correspondents, and 568 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 101,347, an average of 9,195 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The machine and blacksmith shop of the Grand Trunk at Brockville, Ont., were destroyed by fire on November 24.

The members and employees of the Interstate Commerce Commission have subscribed funds to present two ambulances to the Red Cross.

The Denver & Rio Grande has granted an increase in wages of three cents an hour to machinists, boilermakers, blacksmiths and sheet metal workers on its line in Utah.

A general increase in the pay of shopmen on the Pennsylvania Railroad east of Pittsburgh and Erie was announced this week, affecting, it is said, about 10,000 persons. Some clerks are also affected.

According to report, Prof. E. C. Schmidt, head of the department of railway mechanical engineering at the University of Illinois, has received a commission as major in the ordnance department of the Officers' Reserve Corps and hereafter will have headquarters at Washington, D. C.

A compilation of state regulations regarding the housing of railroad employees, prepared by the Bureau of Railway Economics, shows that eight states—Arkansas, Kansas, Mississippi, North Carolina, Oklahoma, Oregon, South Carolina and Texas—have laws requiring railroads to maintain sheds over tracks where car repair work is regularly carried on.

Gold medals bearing the Southern Pacific safety emblem and suitably engraved were awarded recently to the six employees of each division and in each general shop of the Pacific system who, during the year ended June 30, 1917, did the most in furtherance of safety work. C. H. Rippon, piecework inspector of the Sacramento general shops, carried off the first prize for the second successive time.

The Chicago & North Western and the Chicago, Burlington & Quincy have elected to operate under the provisions of the Wisconsin workmen's compensation act, and have filed certificates. This means that the law will apply to shop men, section hands and all other employees of these roads except those engaged in interstate commerce, whose rights to recovery when injured are governed by the federal employers' liability law. Heretofore only the M., St. P. & S. S. M. and the Great Northern have been subject to the Wisconsin act.

Henry B. Endicott, manager of the Massachusetts Public Safety Committee, acting as arbitrator in the recent differences between the Boston & Maine Railroad and its shop and other employees, has decided that the employees are not entitled to the additional three cents an hour in their pay which they asked for. Their threat to strike for an increase of eight cents an hour was temporarily settled by the road paying an advance of five cents an hour and leaving the difference, three cents, to arbitration; and the result has now been announced. The arbitrator says that he is absolutely clear in the view that the five cents advance has set the men on at least as high a basis as the average in the Eastern half of the country.

Steel Prices Reduced

An agreement between the War Industries Board and representatives of the steel interests fixing maximum prices on a number of steel articles, supplementing the basic prices covered by the agreement of September 24, was announced on October 11 with the approval of the President. The prices, which became effective immediately and are subject to revision on January 1, are as follows:

Commodity		Price agreed upon	Base
Blooms and billets 4 in. by 4 in. and larger		$47.50 g.t.	Pittsburgh and Youngstown
Billets under 4 in. by 4 in		51.00 g.t.	Pittsburgh and Youngstown
Slabs		50.00 g.t.	Pittsburgh and Youngstown
Sheet bars		51.00 g.t.	Pittsburgh and Youngstown
Wire rods		57.00 g.t.	Pittsburgh
Shell bars	3 in. to 5 in.	3.25 per 100 lb.	Pittsburgh
	Over 5 in. to 8 in.	3.50 per 100 lb.	Pittsburgh
	Over 8 in. to 10 in.	3.75 per 100 lb.	Pittsburgh
	Over 10 in.	4.00 per 100 lb.	Pittsburgh
Skelp	Grooved	2.90 per 100 lb.	Pittsburgh
	Universal	3.15 per 100 lb.	Pittsburgh
	Sheared	3.25 per 100 lb.	Pittsburgh

First Shipments of Tobacco to Railway Regiments

The Railway Regiments' Tobacco Fund has now become large enough for the commencement of shipments to the railway regiments in France, and the committee in charge of the fund, of which F. A. Poor is chairman, ordered the first shipment to be made on December 1. The shipment on that date consisted of nine cases of tobacco, one for each of the railway regiments now in France. Each case contained twelve 20-lb. packages of tobacco and each package contained 15 pounds of Bull Durham in one-ounce bags with the necessary cigarette papers, and five pounds of Tuxedo smoking tobacco in one-ounce bags. The tobacco will be delivered to the Quartermaster's Department of the United States army in

New York City and the Quartermaster's Department will handle the shipments to Europe.

A large number of contributions were received for the Railway Regiments' Tobacco Fund from railway supply companies during the month of November, subscriptions having been received from the following companies:

Adams & Westlake Company, Chicago	$10 a month
American Arch Company, New York....(to cover 15 months)	150
American Vulcanized Fibre Company, Boston, Mass.	10 a month
Anchor Packing Company, Philadelphia, Pa.	10 a month
Anti-Creeper Corporation, New York	10 a month
Belle City Malleable Iron Company, Racine, Wis.	10 a month
Bettendorf Company, Bettendorf, Iowa	10 a month
Burden Sales Company, New York.....(to cover 6 months)	60
Butler Drawbar Attachment Company, Cleveland, Ohio (contribution)	50
Carnegie Steel Company, Pittsburgh, Pa.	10 a month
Chambers Valve Company, New York	5 a month
Chicago Malleable Castings Company, Chicago	10 a month
Chicago Railway Equipment Company, Chicago (contribution).	100
Chicago Railway Signal & Supply Company, Chicago (to cover 3 months)	30
Cleveland Frog & Crossing Company, Cleveland, Ohio	10 a month
Crucible Steel Company of America, Chicago	10 a month
Curtain Supply Company, Chicago	10 a month
Damascus Bronze Company, Pittsburgh, Pa.	10 a month
Dearborn Chemical Company, Chicago	10 a month
Paul Dickinson, Inc., Chicago	10 a month
Edison Storage Battery Company, Orange, N. J.	10 a month
Elliott Frog & Switch Company, East St. Louis, Mo.	10 a month
Fairbanks, Morse & Co., Chicago	10 a month
Fowler Car Company, Chicago.....(to cover 2 months)	20
Fort Pitt Malleable Iron Company, Pittsburgh, Pa.	10 a month
Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa...	10 a month
Franklin Railway Supply Company, New York (to cover 6 months)	60
Homestead Valve Manufacturing Company, Pittsburgh, Pa....	10 a month
H. C. Holloway, Chicago	10 a month
Hunt-Spiller Manufacturing Corporation, Boston, Mass.	10 a month
Illinois Car & Manufacturing Company, Hammond, Ind. (to cover 6 months)	60
Joliet Railway Supply Company, Chicago	10 a month
Kelly Reamer Company, Cleveland, Ohio (contribution)	10
Kerite Insulated Wire & Cable Company, New York	10 a month
Keyoke Railway Equipment Company, Chicago	10 a month
Keystone Grinder & Manufacturing Company, Pittsburgh, Pa..	10 a month
Laas & Sponenburg Company, Chicago	10 a month
Laconia Car Company, Laconia, N. H.	10 a month
Locomotive Superheater Company, New York (to cover one year to November, 1918)	120
C. F. Massey Company, Chicago	10 a month
J. E. Meek, New York.....(to cover 6 months)	60
Miller Train Control Corporation, Staunton, Va.	10 a month
Milwaukee Coke & Gas Company, Milwaukee, Wis.	10 a month
W. H. Miner, Chicago	10 a month
Mount Vernon Car Manufacturing Company, Mt. Vernon, Ill..	10 a month
National Malleable Castings Company, Cleveland, Ohio	10 a month
Ottenheimer & Co., Chicago	10 a month
Pickands, Brown & Co., Chicago.....(to cover 15 months)	150
Pilliod Company, New York	10 a month
Pittsburgh Wood Preserving Company....(to cover 2 months)	20
Ramapo Iron Works, Hillburn, N. Y.	10 a month
Republic Rubber Company, New York	10 a month
Clive Runnells and Le Roy Kramer, of the Pullman Company, Chicago	10 a month
F. K. Shults, New York (contribution)	25
St. Louis Frog & Switch Company, St. Louis, Mo.	10 a month
T. W. Snow Construction Company, Chicago (to cover 3 months)	30
Steel Car Forge Company, Pittsburgh, Pa.	10 a month
Strobel Steel Construction Company, Chicago	10 a month
T. H. Symington Company, Chicago	10 a month
Templeton, Kenly & Co., Chicago	10 a month
Joseph K. Turbell, of American Brake Shoe & Foundry Company, New York.....(to cover 6 months)	60
Union Draft Gear Company, Chicago.....(to cover 6 months)	60
Union Spring & Manufacturing Company, Pittsburgh, Pa. (to cover 6 months)	60
Union Switch & Signal Company, Swissvale, Pa.	10 a month
H. Vissering & Co., Chicago	10 a month
Waterbury Battery Company, Waterbury, Conn.	10 a month
Watson-Stillman Company, Aldene, N. J.	10 a month
Western Railway Equipment Company, St. Louis, Mo.	10 a month
H. H. Westinghouse, New York	10 a month
Westinghouse Air Brake Company, Pittsburgh, Pa.	10 a month
W. H. Woodin, of American Car & Foundry Company, New York.....(to cover 6 months)	60

The subscribers now total 118, the previous subscribers being given in the *Railway Mechanical Engineer* for November, 1917, on page 616.

Fuel Orders for Lehigh Valley and the C. & O.

Orders intended to insure an adequate supply of coal to the Lehigh Valley and the Chesapeake & Ohio have been issued by the United States Fuel Administration. The orders will distribute equitably among the mines adjacent to the roads the burden of furnishing the roads' fuel supply. Both orders took effect on November 19. Mines now under contract to supply the railroads with coal will be required to supply their quota at their contract prices. Other mines will be required to furnish a pro rata supply, and at prices fixed by the government. The railroads will be required to file with the Fuel Administration each week a schedule of the tonnage which must be requisitioned for the next week's supply. The requisition order will be given priority over all contracts for other parties. The Lehigh Valley draws its supply from mines which are not located on its own lines. These mines are ordered to give priority to the demands of the Lehigh Valley, even over requisitions for coal to supply the railroads upon which they are located.

On November 26, similar orders were issued in favor of the New York, New Haven & Hartford and the Central New England. The order directs all mines under contract with these railroads to give preference to the contract requirements over other shipments, except where coal is diverted by direct requisition of the Fuel Administration.

Suit for Violation of Safety Appliance Act Decided in Favor of the Railroad

In a suit for penalties under the Safety Appliance Act it was alleged that the Boston & Maine Railroad hauled over its road, from Gardner, Mass., westward to East Deerfield, a box car which was out of repair by reason of a coupler being missing from the A end of the car. The car, billed from South Mills, Me., to Lake Junction, N. Y., was in a train which left Boston during the night of August 23, 1916; it became defective and was left behind at Gardner, between 1 and 2 o'clock the next morning, with one drawbar pulled out. It was turned around and was attached by its good coupler, behind the caboose, on a freight train going west from Gardner at 7:40 a. m. on August 24. On this train it was taken to East Deerfield, where it was repaired. This was the movement on which the complaint was based. The car contained about 45 pieces of freight, including one cask of gasolene.

Gardner is not a repair point for handling such defects as the car developed. The nearest such point was Fitchburg, 17 miles east from Gardner; East Deerfield is 38 miles west. The freight in the car was destined to points west. The government contended that the car ought to have been taken to Fitchburg, because the distance was shorter. The Federal District Court held that the word "available" in the phrase "to the nearest available point" in the statute cannot be ignored. Availability obviously depends, under the statute, on other conditions besides that of mere distance. Whether Fitchburg was, under all the circumstances, the "nearest available" point for the repair of this car was a matter of business judgment. Upon such a question, involving as it

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Dec. 11, 1917	Oxy-Acetylene and Electric Welding and Cutting Processes in Locomotive Work..	A. F. Dyer	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Jan. 11, 1918			Harry D. Vought.	95 Liberty St., New York.
Cincinnati	Feb. 12, 1918			H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Dec. 11, 1917	Fuel	W. L. Robinson	W. E. Cade, Jr..	683 Atlantic Ave., Boston, Mass.
New York	Dec. 21, 1917	Address: Nationalization of American R'l'ds	Arthur M. Thompson.	Harry D. Vought.	95 Liberty St., New York.
Pittsburgh	Dec. 28, 1917			J. B. Anderson..	207 Penn. Station, Pittsburgh, Pa.
St. Louis	Dec. 14, 1917	Patriotic address	Hon. Frederick Landis	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn.	Jan. 17, 1918			A. J. Merrill	Grand Building, Atlanta, Ga.
Western	Dec. 17, 1917	The Box Car	W. J. Bohan	J. W. Taylor	1112 Karpen Bldg., Chicago.
		Address	A. M. Schoyer		

does many elements, the decision of the men in charge of the business, if made in good faith, is entitled to serious consideration. It was not shown to have been wrong in this instance. On some of the freight speedy delivery may have been important, and it did not appear that there was any car at Gardner into which it could have been transferred. Although the distance of the haul was 20 miles longer than that to Fitchburg, the car "gained on the voyage," and its presence did not appear to have substantially increased the risk of injury to employees. Judgment was entered for the defendant.

Shop Crafts Federate to Press Demands

The various shop crafts on the railroads north, south and west of Chicago, including the Chicago & Eastern Illinois, the Illinois Central, the Chicago & Alton and the Wabash, have federated into one body and have distributed ballots among the members to determine what action shall be taken on the following proposed demands: (1) $5 for a day of 8 hours for machinists, blacksmiths, boilermakers, sheet metal workers and electricians; (2) $4.50 per day of 8 hours for car men, including pattern makers, cabinet makers, coach and locomotive carpenters, upholsterers, painters, varnishers, letterers and machine operators in planing mills; (3) $3.50 per day of 8 hours for the first 6 months and $4 thereafter for all other car men; (4) $3.50 per day of 8 hours for helpers in all crafts; (5) for regular apprentices, 20 cents an hour for the first six months and an increase of 2½ cents per hour for each six months thereafter for the first three years, a 5-cent an hour increase for the first 6 months of the fourth year and 7½ cents for the last six months of the fourth year; (6) helper apprentices to start at the minimum wage for helpers for the first six months and to receive an increase of 2½ cents per hour for each six months until the time of apprenticeship has been served; (7) foremen and other men employed by the month to receive a minimum increase of $20 per month.

No member of a shop craft is to receive an increase of less than 10 cents an hour except apprentices. The ballots are returnable by December 10 and a general meeting of the federation will be held on January 4, 1918.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postponed.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

Master Car Builders' Association.—J. W. Taylor, Karpen Bldg., Chicago, Convention postponed.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention postponed.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

PERSONAL MENTION

GENERAL

Clyde E. Barnes, mechanical engineer of the Spokane, Portland & Seattle, has enlisted in the navy. He will take the Harvard or Columbia four-months' course in electrical or mechanical instruction for motor boat submarine chasing, after which he will be rated as a machinist's mate in the navy.

W. O. Cook, general road foreman of engines of the Denver & Rio Grande, has been appointed assistant superintendent of the motive power and car departments, with headquarters at Burnham station, Denver, Col. The office of general road foreman has been abolished, but the duties of the position have been assumed by Mr. Cook.

C. H. Crawford, assistant engineer in the mechanical department of the Nashville, Chattanooga & St. Louis, has been loaned to the War Industries Board of the Council of National Defense for service on the storage committee.

Samuel J. Hungerford, whose appointment as general manager of the eastern lines of the Canadian Northern, with office at Toronto, Ont., was noted in the November number, was born on July 16, 1872, at Bedford, Que., and was educated in the common and high schools. In 1886 he engaged in railroad work as a machinist apprentice of the South Eastern and later served with its successor, the Canadian Pacific, at Farnham, Que. He was then machinist at various places in Ontario and Quebec. On September 3, 1894, he was appointed assistant roundhouse foreman of the Canadian Pacific at Windsor street, Montreal, and three years later he was transferred to Farnham, Que., as assistant foreman, which position he also held for three years, when he was made locomotive foreman at Megantic, Que. In the following year, 1901, he was advanced to general foreman at McAdam Junction, N. B., and in October of that year was transferred to Cranbrook, B. C., where he acted in the same capacity. In 1903 he was promoted to master mechanic of the Western division with headquarters at Calgary, Alberta. On January 25, 1904, he went to Winnipeg as superintendent of the locomotive shops and on January 1, 1908, was made superintendent of shops. On March 1, 1910, he left the Canadian Pacific to accept the position of superintendent of rolling stock of the Canadian Northern and the Duluth, Winnipeg & Pacific, with office at Winnipeg. On May 1, 1915, his jurisdiction was extended to include all the rolling stock on the 10,000-mile system of the Canadian Northern, his headquarters being moved to Toronto. It is this position which he now leaves to become general manager of the eastern lines.

S. J. Hungerford

D. G. Cunningham has been appointed assistant superintendent of the motive power and car departments of the Denver & Rio Grande, with headquarters at Salt Lake City.

Utah. Mr. Cunningham has also assumed the duties of E. J. Harris, master mechanic, who has resigned.

G. W. DEATS, master mechanic of the Texas & Pacific at Ft. Worth, Tex., has been appointed traveling supervisor of fuel and oil on the Ft. Worth division, with headquarters at Ft. Worth.

WILLIAM H. FETNER, acting superintendent motive power of the Central of Georgia at Savannah, Ga., has been appointed superintendent of motive power; Frederick F. Gaines, superintendent of motive power, who was granted leave of absence in September on account of continued ill health, has been assigned to other duties.

J. L. LAVALLE, master mechanic of the New Orleans, Texas & Mexico at De Quincy, La., has been appointed assistant superintendent, with office at De Quincy.

R. E. LEE, acting manager of the mining and fuel department of the Chicago, Rock Island & Pacific, has been appointed manager of the mining department with jurisdiction over mines and mining operations, with headquarters at Chicago.

W. W. LEMEN has been appointed superintendent of the motive power and car departments of the Denver & Rio Grande, with headquarters at Denver, Col., succeeding W. J. Bennett, resigned.

CHARLES MANLEY, whose appointment as superintendent of machinery of the Missouri & North Arkansas, with headquarters at Harrison, Ark., was announced in the *Railway Mechanical Engineer* for November, was born on September 10, 1867, at Nashville, Tenn. He began railway work on May 1, 1883, with the Texas & Pacific at Big Springs, Tex., and after serving an apprenticeship of four years as machinist with that road, he was employed as machinist by various railroads in the Southwest and West, including the Mexican National, with which he was identified until May, 1910. While with the latter road he was employed successively as general foreman at Laredo, master mechanic at Mexico City, and superintendent of shops at Aguas Calientes. He left Mexico on account of the revolution, but returned in December, 1910, as master mechanic of the Vera Cruz Terminal Company at Vera Cruz, Mex. Subsequently he became superintendent of motive power of the Tehuantepec National. On August 1, 1912, he went to the Missouri & North Arkansas as terminal foreman, one month later he was promoted to master mechanic, and on July 1, 1916, was appointed superintendent at Harrison, Ark., which position he held until his recent appointment as superintendent of machinery.

G. W. MCGOWAN, traveling machinery inspector of the Southern Pacific, has been appointed assistant superintendent of the Texas & New Orleans and of the Galveston division of the Galvestin, Harrisburg & San Antonio.

W. L. MCMURRY, an engineer on the Ft. Worth division of the Texas & Pacific, has been appointed supervisor of fuel on the Rio Grande division, with headquarters at Big Spring, Tex.

E. S. PEARCE has been appointed mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Beech Grove, Ind., succeeding W. E. Ricketson.

CARL SCHOLZ, consulting mining engineer of the Chicago, Burlington & Quincy, at Chicago, has been appointed a member of the Committee of Consulting Engineers on Coal Conservation and Publicity, for the Bureau of Mines, Washington, D. C. A photograph of Mr. Scholz and a sketch of his career were published in the *Railway Mechanical Engineer* for July, 1917, on page 415.

M. TURTON has been promoted to mechanical superintendent of the International Railways of Central America, with office at Guatemala City, Guatemala, in place of R. Potts, who has resigned to go to another railroad company.

WILLIAM B. WHITSITT, shop engineer of the Baltimore & Ohio, has been appointed assistant chief draftsman in the mechanical department drawing room, at Baltimore, Md.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

L. L. ALLEN, general foreman of the St. Louis, Brownsville & Mexico at Kingsville, Tex., has been appointed master mechanic of the Gulf Coast Lines, with headquarters at De Quincy, La.

J. W. COULTER has been appointed master mechanic of the Alton & Southern, with headquarters at East St. Louis, Ill.

T. S. DAVEY, shop superintendent of the Erie at the Buffalo car shops, has been appointed master mechanic in charge of engine terminals at Croxton, N. J.

J. A. DELANEY, master mechanic of the Rio Grande division of the Texas & Pacific, with headquarters at Alexandria, La., has been transferred to Big Spring, Tex.

E. J. HARRIS, master mechanic of the Denver & Rio Grande at Salt Lake City, Utah, has resigned, his duties being assumed by D. G. Cunningham.

W. R. HARRISON has been appointed master mechanic of the Southern Kansas division of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan., succeeding W. H. Hamilton, assigned to other duties.

W. H. KELLER, master mechanic of the Texas & Pacific at Big Spring, Tex., has been transferred to the Ft. Worth division, with headquarters at Ft. Worth, Tex., succeeding G. W. Deats.

C. E. PECK, general foreman for the Southern Pacific at Roseville, Cal., has been promoted to master mechanic of the Portland division, with headquarters at Portland, Ore., succeeding George Wild, resigned.

E. P. SMITH has been appointed road foreman on the Minnesota division of the Northern Pacific, with headquarters at East Grand Forks, Minn., succeeding L. L. Moebeck, transferred.

C. A. WERTH, road foreman of engines of the Northern Pacific at Pasco, Wash., has been appointed master mechanic of the Pasco division, with headquarters at Pasco, succeeding G. F. Egbers, granted leave of absence to enter the Russian railway service corps.

CAR DEPARTMENT

L. C. FITZGERALD, car foreman of the Erie at Buffalo, N. Y., has been appointed shop superintendent at the Buffalo car shops to succeed T. S. Davey.

SHOP AND ENGINEHOUSE

B. G. GAMBLE, roundhouse foreman of the Gulf, Mobile & Northern, has been appointed roundhouse foreman of the St. Louis-San Francisco at Sapulpa, Okla.

L. W. HENDRICKS, master mechanic of the New York division of the New York, New Haven & Hartford, has been appointed superintendent of shops at Van Nest, N. Y., succeeding J. L. Crouse, resigned.

W. H. JAMES, roundhouse foreman of the Chicago & North Western, at Boone, Iowa, has received a commission as lieutenant in the railway regiment recently organized for service in Russia.

PURCHASING AND STOREKEEPING

R. L. AGNER has been appointed division storekeeper of the Southern Railway, with office at Alexandria, Va., succeeding A. B. Lackey, resigned to enter service of United States Army.

H. M. DEWART has been appointed assistant purchasing agent of the Central Vermont, with office at St. Albans, Vt.

W. W. ELDRIDGE has been appointed storekeeper of the Chicago, Burlington & Quincy at Sheridan, Wyo., succeeding M. Josselyn, assigned to other duties.

I. G. MORRISON, store inspector of the Chicago, Burlington & Quincy, has succeeded W. W. Eldridge as storekeeper at Havelock, Neb.

F. D. REED, general purchasing agent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, Ill., will also have charge of the inspection and distribution of the company's fuel. The conservation of fuel used in locomotives, stationary plants and pumping stations will be under the supervision of the mechanical department. The operation and maintenance of coal chutes will be under the jurisdiction of the transportation department and directly in charge of the division superintendent. The above reorganization became effective December 1.

R. E. SCOTT, whose appointment as purchasing agent of the Spokane, Portland & Seattle, with headquarters at Portland, Ore., was announced in the November *Railway Mechanical Engineer*, was born July 17, 1887, at Barnesville, Minn., and graduated from the mechanical engineering department of Purdue University in 1911. The same year he entered the service of Fairbanks, Morse & Co., at Jacksonville, Fla., where he remained until August, 1914, when he became eastern representative of the Gurney Refrigerator Company at New York. On September 1, 1914, he was appointed roadmaster of the Oregon Electric, which position he held until September 30, 1917, when he was appointed purchasing agent of the Spokane, Portland & Seattle, succeeding S. M. Clark, resigned.

R. E. Scott

E. J. SHIELDS has been appointed general storekeeper of the Kansas City, Mexico & Orient, with headquarters at West Wichita, Kan., succeeding C. A. Keller, resigned to accept service with the United States government.

C. T. WINKLESS, superintendent of fuel of the Chicago, Rock Island & Pacific, at Chicago, has been transferred to the purchasing department, reporting to F. D. Reed.

NEW SHOPS

OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY.—This road is building a roundhouse at Tacoma, Wash., which will cost about $10,000. The building will contain three stalls, 97 ft. long. It will be a frame structure with concrete pits and concrete footings supported on piles. The contract for the work was let to the E. J. Rounds Construction Company, Seattle, Wash.

GULF, COLORADO & SANTA FE.—This company is contemplating the construction of a freight station and a machine shop at Temple, Tex. The proposed machine shop will be 60 ft. by 100 ft., with concrete foundations, brick walls, machinery foundations, electric light, steam heat and tar and gravel roof. The structure will cost $15,000, exclusive of machinery.

SUPPLY TRADE NOTES

The Combustion Engineering Corporation, Chicago, announces that six men in its drafting room have joined the colors.

Howard D. Taylor, of the Remington Arms Company, Eddystone, Pa., has been elected vice-president of McCord & Co., Chicago.

J. M. Betton, maker of injector sand blast apparatus, formerly at 26 Park Place, has removed his office to 59 Pearl street, New York.

H. P. Edison of the Washington Steel & Ordnance Company, Washington, D. C., will represent the Vanadium Alloys Steel Company in the Pittsburgh district.

M. J. Madison has resigned as Chicago district manager of the Vanadium Alloys Steel Company to accept a position with the Weir Frog Company of Cincinnati, Ohio.

Allen R. Miller, of the B. F. Goodrich Company, railroad sales department, at Akron, Ohio, has been transferred to the B. F. Goodrich Rubber Company, 1780 Broadway, New York, as eastern representative.

Henry Gaul, who for many years was connected with the Ajax Manufacturing Company of Cleveland, Ohio, died recently. He had a wide acquaintance among railroad men and was known as an expert on forging machine matters.

Joseph Sinkler has resigned as western representative of the Economy Devices Corporation to become special representative in Chicago and tributary territory for the Perolin Railway Service Company.

Mr. Sinkler was born at Scranton, Pa., on December 14, 1874, and began his mechanical career with the Dickson Locomotive Works in the same city. He remained with that company three years and later was employed on the New York, Susquehanna & Western two years and for the succeeding two years on the Delaware, Lackawanna & Western. He became associated with the Franklin Railway Supply Company on July 1, 1904, and continued with that company until January 1, 1916, when he was appointed western representative of the Economy Devices Corporation at Chicago. He assumed his duties as special representative of the Perolin Railway Service Company on November 15.

J. Sinkler

W. R. Toppan, who for 15 years was identified with the Kennicott Company, which recently discontinued business, is now manager of the railroad department of the William Graver Tank Works, Chicago, the new proprietor of the Kennicott type "K" water softener.

Don L. Clement, eastern railway representative of Pratt & Lambert, Buffalo, N. Y., with offices in New York, has received a commission as first lieutenant of the 35th Regiment Railway Engineers, now stationed at Rockford, Ill.

The National Railway Appliance Company, New York, has been made the eastern and southern representative of the Valley Steel Company of East St. Louis, Ill., and will handle its full line of axles, locomotive driving axles, piston rods, side rods and crank shafts, in normal or heat treated grades.

Peter H. Murphy, president of the Standard Railway Equipment Company, New Kensington, Pa., died at Pittsburgh, Pa., on November 7. Mr. Murphy was born at Bennington, Vt., on March 16, 1846. He served as machinist apprentice and locomotive engineer on the Erie and was also an engineer on the Pennsylvania Railroad and on the Union Pacific, running the first night express west out of Omaha. He was later division master mechanic of the Baltimore & Ohio at Cumberland, Md., master mechanic of the Toledo, St. Louis & Western and general master mechanic of the Cairo Short Line. He left railroad work in 1888 to engage in the manufacture of car roofs.

W. J. Schlacks, general manager of McCord & Co., Chicago, was recently elected director and vice-president of that company, with headquarters at Chicago. Mr. Schlacks was born in Chicago on March 28, 1874. His first railroad experience was as a machinist apprentice on the Illinois Central. Later he went with the Denver & Rio Grande, after which he entered Leland Stanford, Jr., University. Following his graduation from college he was appointed assistant mechanical engineer on the Denver & Rio Grande. He was later appointed mechanical engineer on the Colorado & Midland, following which he was general foreman and superintendent of machinery on the same road. In September, 1906, Mr. Schlacks was appointed western sales agent of McCord & Co. and in October, 1914, was promoted to general manager with headquarters in Chicago. As vice-president he will continue to have headquarters at Chicago.

W. J. Schlacks

L. F. Hamilton, manager of the advertising and specialty department of the National Tube Company, Pittsburgh, Pa., on December 1 became associated with the Walworth Manufacturing Company, Boston, Mass., and was succeeded by W. L. Schaeffer, his assistant. The Walworth Manufacturing Company recently purchased the Kewanee works and the Kewanee line of products from the National Tube Company. Mr. Hamilton will take up approximately the same duties with the company that he had with the National Tube Company, more particularly the training of specialty students, the supervision of specialty and sales promotion work, etc.

Charles H. Stoer and M. A. Sherritt, of the Sherritt & Stoer Company, Inc., machinery dealers of Philadelphia, who recently acquired the stock of the Betts Machine Company of Wilmington, Del., have disposed of the real estate, buildings and equipment to E. I. du Pont de Nemours & Co. The business of the Betts Machine Company will be continued with improved facilities since the new owners retain the good will, patents, patterns, drawings, jigs, fixtures, etc. The new officers are: M. A. Sherritt, president; Geo. W. Moreton, vice-president, and C. H. Stoer, secretary-treasurer, and the general offices have been moved to the Finance building, Philadelphia.

Economy Devices Corporation and Franklin Railway Supply Company Merged

With a view to concentrating into one organization two groups of men who have been working along parallel lines in the development of increased efficiency of the steam locomotive, the Economy Devices Corporation and the Franklin Railway Supply Company have been merged into a new corporation, namely, the Franklin Railway Supply Company, Inc.

J. S. Coffin

The officers of the new company will be as follows: J. S. Coffin, chairman of the board of directors; S. G. Allen, vice-chairman; H. F. Ball, president; Walter H. Coyle, senior vice-president; J. L. Randolph, vice-president in charge of western territory; C. W. Floyd Coffin, vice-president in charge of eastern and southern territory; C. L. Winey, secretary and treasurer; Harry M. Evans, eastern sales manager; C. J. Burkholder, western sales manager; Hal R. Stafford, chief engineer, and William T. Lane, mechanical engineer.

Joel S. Coffin, chairman of the board of directors, brings to the new company a wide and varied knowledge gained from 14 years of railroad work and 26 years in the railroad supply field. He began as machinist apprentice and became fireman, engineer and road foreman of engines. Most of his experience was on the Wisconsin Central. He left the railroad to enter the mechanical department of the Galena Signal Oil Company as mechanical expert, was promoted to manager of that department and several years later was elected vice-president. After serving as vice-president for two years, he resigned to accept the vice-presidency of the American Brake Shoe & Foundry Company, which position he held until 1911. In 1902 he organized the Franklin Railway Supply Company, of which he was president up to 1916, when he was elected chairman of the board. In addition to being chairman of the board of directors of the Franklin Railway Supply Company, Inc., Mr. Coffin is a director in a large number of other corporations.

S. G. Allen

Samuel G. Allen, vice-chairman of the Franklin Railway Supply Company, Inc., is both a lawyer and a business man. He was plunged into business responsibilities immediately after leaving college and studied law in his spare time. He was admitted to the bar in Warren County, Pa., and practiced for nine years in the oil districts of Pennsylvania. When the Franklin Railway Supply Company was formed

in 1902, Mr. Allen was elected secretary and treasurer, and later became vice-president, and in 1916 was elected president.

H. F. Ball

H. F. Ball, president of the Franklin Railway Supply Company, Inc., has spent his entire business life in intimate contact with locomotive operation and construction. After serving his time in the locomotive and car departments of the Pennsylvania Railroad at Altoona, he entered the drafting room, and two years later entered the service of the Lake Shore & Michigan Southern as chief draftsman. He held successively the positions of general foreman car shops, general car inspector, mechanical engineer and superintendent of motive power. He resigned from the Lake Shore to become vice-president in charge of engineering of the American Locomotive Company, which position he occupied until 1913, when he left the company to become president of the Economy Devices Corporation.

W. H. Coyle

Walter H. Coyle, senior vice-president of the Franklin Railway Supply Company, Inc., brings to his new position experience gained by many years in both railroad work and the railroad supply field. Mr. Coyle was for 11 years in the service of the Erie Railroad in the mechanical and traffic departments. Upon leaving the railroad he became identified with the Kent Manufacturing Company, and later entered the mechanical department of the Franklin Railway Supply Company. He spent six years in this department, when he was called to New York as assistant to the vice-president and placed in charge of the sales department of the central territory. He was elected second vice-president shortly after, and then vice-president, which position he held up to the time of his election as senior vice-president of the new organization.

J. L. Randolph

J. L. Randolph, vice-president of the Franklin Railway Supply Company, Inc., takes charge of the western territory, with office in Chicago. Mr. Randolph began as a machinist apprentice in the Concord, N. H., shops of the Northern Railroad, now a part of the Boston & Maine. Subsequently he served this road in the capacity of machinist, gang foreman, general foreman, master mechanic and superintendent of shops. He left the railroad to accept a position in the mechanical department of the Franklin Railway Supply Company. Three years later he was appointed sales manager of the Economy Devices Corporation, and in 1906 was elected vice-president.

C. W. F. Coffin

C. W. Floyd Coffin, vice-president of the Franklin Railway Supply Company, Inc., takes charge of the eastern-southern territory, with office in New York. Mr. Coffin's entire business experience has been in the railroad supply field. After leaving Cornell University he spent five years in the treasury, sales and service departments of the Franklin Railway Supply Company. He was then transferred to Chicago as assistant western sales manager, and later promoted to western sales manager, which position he held up to the time of his appointment as vice-president of the Franklin Railway Supply Company, Inc.

C. L. Winey, secretary and treasurer of the Franklin Railway Supply Company, Inc., is a man of extended experience, both in railroad work and in the railroad supply field. Starting his career on the Pennsylvania Railroad, he spent three years in the motive power department, one year in the maintenance of way and signal department, and two years in the transportation department. He left railroad work to enter the service of the Galena Signal Oil Company, and five years later accepted the position of secretary and works manager of the Kent Manufacturing Company. In 1908 he was elected secretary and treasurer of the Franklin Railway Supply Company, which position he held until he was elected secretary and treasurer of the Franklin Railway Supply Company, Inc.

C. L. Winey

Harry M. Evans has been appointed eastern sales manager of the Franklin Railway Supply Company, Inc., with office in New York. Mr. Evans began railroad work as a call boy on the Erie, and served in various positions in the mechanical, transportation and traffic departments of that road. Upon leaving the Erie he entered the mechanical department of the Franklin Railway Supply Company as traveling representative. He was promoted to assistant western sales manager, and shortly after was made eastern sales manager, which position he held at

the time of his recent appointment as eastern sales manager of the Franklin Railway Supply Company, Inc.

C. J. Burkholder has been appointed western sales manager of the Franklin Railway Supply Company, Inc., with office in Chicago. Up to 1916 Mr. Burkholder's business experience had been entirely in railroad work. He was employed in the roundhouse of the Pennsylvania Railroad at Tyrone, Pa.; and later was a locomotive fireman. Leaving the Pennsylvania Railroad, he became a locomotive engineer on the Union Pacific, and later on the Kansas City Southern. He was in turn promoted to traveling engineer, trainmaster, general road foreman of engines and division superintendent. In 1916 he accepted a position with the Economy Devices Corporation as mechanical representative in the western territory, which he held up to his present appointment.

Hal R. Stafford, chief engineer of the Franklin Railway Supply Company, Inc., has for the past 17 years been active in locomotive development. On leaving college he started as a special machinist with the Schenectady Locomotive Works, and shortly afterward was transferred to the drawing room. A year later he took charge of the cylinder and valve division. Eight years later he was made assistant to the consulting engineer in charge of compound locomotives. While in this position he helped develop the first Mallet locomotive, the Cole balanced compound and the Cole-Stafford balanced simple locomotive. For some years he represented the American Locomotive Company, conducting road tests joint with various railroads. When the Economy Devices Corporation was formed he was appointed mechanical engineer of that company.

William T. Lane, mechanical engineer of the Franklin Railway Supply Company, Inc., has spent his entire business career in the railway supply field. For the past six years he has been constantly in touch with locomotive development. On leaving college he went as an apprentice with the Franklin Portable Crane & Hoist Company. His next position was as draftsman for the Franklin Railway Supply Company, then chief draftsman. In 1915 he was made mechanical engineer.

Charles A. Carscadin, president of the National Car Equipment Company, Chicago, has been elected vice-president of the Joliet Railway Supply Company, Chicago. James H. Slawson, vice-president of the Joliet Railway Supply Company, has been elected a vice-president of the National Car Equipment Company.

E. A. Hawks, of Detroit, has been appointed special representative for the Youngstown Steel Car Company, Youngstown, Ohio. Mr. Hawks will handle the selling of the products of this concern to certain railway companies, and also among the automobile companies. His office is in the Dime Bank building, Detroit, Mich.

L. R. Dressler, traveling inspector of the American Arch Company, New York, has received a commission as first lieutenant in the Ordnance Officers Reserve Corps. Mr. Dressler had been in the employ of the American Arch Company since May, 1916, previous to which he was a special apprentice of the New York Central at West Albany.

R. L. Browne, who for the past 15 years has been identified with the electrical and mechanical engineering profession, has recently become associated with the sales department of the Goldschmidt Thermit Company, New York, in the capacity of commercial engineer, after having spent several months in the foundry of that company acquiring a practical knowledge of the Thermit process of welding.

The Glazier Manufacturing Company, Rochester, N. Y., one of the oldest manufacturers of headlights, cases and reflectors, has reorganized, and has elected Frank Ocumpaugh president and general manager and Fred Kimmel vice-president. Mr. Kimmel is also president of the Rochester Motors Company. Mr. Ocumpaugh was born in Rochester, New York, and after finishing a common and high school education entered business in 1890 as purchasing agent of the Vacuum Oil Company, Rochester, N. Y. He held that position for 27 consecutive years, during which time the size and business of the Vacuum Oil Company expanded tremendously. Two years ago he went into the real estate business, which he has now given up to devote his time to the manufacture of Glazier products. Oscar F. Ostby, who is manager of sales for the company, maintains headquarters at the Grand Central Terminal, New York. A sketch of Mr. Ostby's life appeared in the November number of the *Railway Mechanical Engineer*.

Lewis A. Larsen, assistant comptroller of the American Locomotive Company, has resigned to accept the position of assistant to the president of the Lima Locomotive Works, Inc., with headquarters at Lima, Ohio. Mr. Larsen was born at Ridgeway, Ia., in 1875. He received his early education in the public schools of Ridgeway and Decorah, Ia., and Upper Iowa University, Northwestern University and St. Paul College of Law. In November, 1897, he entered the service of the Chicago Great Western as clerk to the master mechanic. He held successively the positions of chief clerk to the superintendent of motive power and chief clerk to the assistant general manager. In 1904 he resigned to accept the position of chief clerk to the superintendent of motive power of the Northern Pacific at St. Paul. In November, 1906, he became associated with W. H. S. Wright, railway supplies, representing the Railway Steel Spring Company, the Pittsburgh Forge & Iron Company and other companies, and in 1907 entered the service of the American Locomotive Company. In 1909 he was appointed assistant to the vice-president in charge of manufacturing and in July, 1917, was appointed assistant comptroller. For several years past Mr. Larsen has been a special lecturer in the Alexander Hamilton Institute, New York. He has also contributed a number of papers to the railroad magazines.

L. A. Larsen

A Locomotive an Hour

Production records at the Baldwin Locomotive Works are being broken weekly. It is reported that in a recent week about 100 locomotives of various sizes were turned out, and President Alba B. Johnson is authority for the statement that the plant is completing a locomotive an hour.

President Johnson at the directors meeting also said:

"During 1916, 1,960 locomotives were made, an average of 160 a month. Large contracts for machining shells were executed and a considerable portion of the force, which ranged from 12,000 to 18,500 men, was diverted to shell manufacturing. All of these contracts except one, for the French Government, were run out during the spring of 1916. The French contract was completed in November. In 1917 the working force was increased approximately to 20,000 men. Locomotive production was largely increased and for ten months ending October 31, 1917, 2,254 were shipped, at the rate of 225 a month. This increase will be continued during November, December and the months of 1918.

CATALOGUES

ADJUSTABLE HUB PLATES.—A book has been published by the Smith Locomotive Adjustable Hub Plate Company, Chicago, which describes the application and maintenance of the adjustable hub plate, the use of which is licensed by this company.

BRASS FOUNDRY EQUIPMENT.—The Whiting Foundry Equipment Company, Harvey, Ill., has issued catalogue No. 128 describing its furnaces, tongs and tumblers for use in brass foundries. The catalogue contains eight pages, is well illustrated and gives information regarding the various products.

MILLING CUTTERS.—The Cleveland Milling Machine Company, Cleveland, Ohio, is issuing a stock list of milling cutters on the fifteenth of each month. In this stock list each type of milling cutter is illustrated and the number of each size and quality of material which are available for immediate shipment are tabulated. Copies will be furnished on request.

AMERICA'S AIRPLANES.—An interesting booklet bearing this title has been published by the Gisholt Machine Company, Madison, Wis. It contains numerous illustrations showing the development of airplanes and dirigibles from the earliest types to those which are now being built for use in the war zone. There is also a section devoted to airplane engines and the manufacture of engine parts.

INSULATING BRICK.—The Armstrong Cork & Insulation Company, Pittsburgh, Pa., has issued a folder describing tests made to determine the economy in fuel obtained by the use of Nonpareil insulating brick for boiler settings. One illustration is included showing the method of applying the insulating brick in the boiler setting. The tests showed that 63 per cent of the heat lost was saved by the use of this brick.

GRINDING WHEEL REFERENCE CARD.—The American Emery Wheel Works, Providence, R. I., has published a grinding wheel speed and reference card. One side of the card shows the kind of abrasive, grain and grade recommended for various classes of work, while the other side shows the revolutions per minute for speeds of 4,000, 5,000 and 6,000 ft. per minute for wheels ranging from 1 to 60 in. in diameter.

HOISTING MACHINERY FOR INDUSTRIAL WORKS.—Under this title the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has issued a loose-leaf catalogue bound in a heavy manila cover. The catalogue refers in detail to the construction and specifications of the Shepard monorail hoists, gives a complete outline of the terms and conditions of purchase, including prices and discounts. It contains all the information necessary for selecting and specifying the various types and sizes of hoists. Clearance drawings for each type are given.

THE DESIGN OF FORGING MACHINE DIES.—A paper on the "Laws Governing Forging Machine Die Design," by E. R. Frost, general manager of the National Machinery Company, which was read before the American Drop Forge Association, has been reprinted by the National Machinery Company, Tiffin, Ohio, as Forging Machine Talk No. 27. The principles governing the design of dies for forging machines have been reduced to simple rules, and numerous illustrations show the application of these rules in making various classes of forgings. The paper contains information that will be of value in shops where forging machines are used.

OXY-PINTSCH METAL CUTTING.—An attractive eight-page booklet has been issued by the Pintsch Compressing Company, 2 Rector street, New York, describing the model "C" Oxy-Pintsch cutting equipment furnished by this company. This booklet sets forth the advantages of Pintsch gas for metal cutting and contains a brief description with illustrations of the various parts of its complete outfit. This includes an oxygen pressure regulator, high and low pressure Pintsch gas regulators, the use of which depends upon whether the gas is drawn from flasks or from low pressure service pipe lines, and the cutting torch.

UNIVERSAL VERTICAL AND HORIZONTAL BORER.—The Oliver Machinery Company, Grand Rapids, Mich., has issued a four-page folder containing illustrations and specifications of its No. 74 Universal vertical and horizontal wood boring machine. This machine has a single spindle each in the horizontal and vertical positions, which have a capacity of boring holes up to three inches in diameter. The folder also contains illustrations of the Oliver "Little Pattern Makers," which are boring machine cutting tools for use in profiling and core box work, fillet cutting, etc., operations which the pattern maker is often compelled to do by hand.

"HYDRO" PRESSURE AND DRAFT RECORDERS.—Catalogue "D" of the Bacharach Industrial Instrument Company, Pittsburgh, Pa., is an eight-page pamphlet in which is described in detail the design and construction of the "Hydro" recording instruments. The moving element of these recorders is a bell floating in water, to which is attached a recording pen. The position of the pen is determined by the differential pressure between the inside and outside of the bell. The instruments are made in several types, both recording and indicating, for a variety of uses where draft vacuum, low pressures and differential gas pressures are to be measured.

CUTTING AND THREADING TOOLS FOR PIPE.—This is the title of catalogue No. 12 of the Borden Company, Warren, Ohio, a neatly gotten up 32-page booklet covering the "Beaver" line of pipe tools. The line includes a number of types and sizes of die stocks and square-end pipe cutters. In the "Beaver" die stocks, the dies themselves are without taper, the taper thread being cut by automatically moving the dies away from the pipe as the threading operation progresses. Since the dies are straight but few teeth are required, and the range of adaptability is materially increased. The catalogue explains the principle on which these dies operate and contains a complete illustrated list of repair parts.

IRON AND STEEL FOR EXPORT.—The English edition of the new 94-page iron and steel catalogue of the American Steel Export Company is now ready for foreign distribution. The Spanish, French, Portuguese, Italian and Russian editions are to be published shortly, now being in process of preparation. This catalogue contains much information, such as weights and measures in English and metric tables, and data covering such products as pig iron, billets, blooms, slabs and sheet cars, plates and shapes, tool steel, merchant bars and agricultural steel, wire products, pipe and tubing, rails and railway supplies, castings and forgings, sheet and tin plate, etc. The object of the catalogue is to inform overseas buyers concerning American sizes, weights, etc. The booklet also includes specifications covering tolerances and other valuable data.

PENNSYLVANIA HOLDS FAST TRAIN FOR SICK WATCHMAN.—The Pennsylvania Railroad company showed the human side of the corporation one morning recently when it held up one of its through passenger trains running as an extra with first class privileges for half an hour to get a doctor on board who would carry relief to a lone watchman in a little box six miles west of Lewistown Junction, Pa., suffering from an acute attack of cramps. After the doctor had administered first aid to the sick watchman, both were brought to a local hospital in the caboose of a freight train.

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Strength and Chemical Compositions with Scientific Accuracy

No matter what Testing or Laboratory problems may confront you, we can solve them to your entire satisfaction and guarantee you an unbiased analysis and report.

Our organization is entirely that of competent and experienced Engineers, Chemists and Metallurgists who are permanently employed in our departments of Tests, Physical and Chemical Laboratories.

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for Drills with No. 3 Morse Taper Shanks

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Reversible

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We make a complete line of Ratchet Drills, including the Marvelous UNIVERSAL RATCHET DRILL. All kinds, all sizes.

Write for complete free catalog.

ARMSTRONG BROS. TOOL CO.

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329 N. Francisco Ave. Chicago, U. S. A.

ARMSTRONG TOOL HOLDERS WON THE ONLY GRAND PRIZE awarded in the special class for Tool Holders at the Panama-Pacific Exposition.

1

Big Capacity Condensed Into Small Space—

A set of Nicholson Expanding Mandrels, taking from ½" to 7" round or square holes will save time, labor and expense for the machine shop using solid mandrels.

No idle machines while searching through a pile of solids for the nearest size.

No time wasted in preparing one for use.

No money expended for many sizes of mandrels seldom used.

Increased production will be the regular thing if you equip your shop with

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W. H. Nicholson & Company
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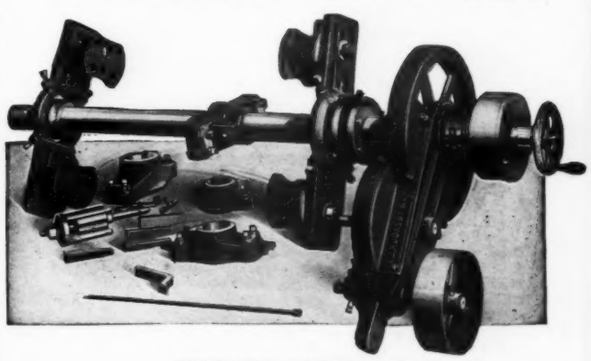
Expanding Mandrel

ROOKSBY PORTABLE TOOLS

FOR RAILWAY REPAIR SHOPS



PORTABLE BORING BAR

Boring Bars for Reboring Locomotive Cylinders and Valve Chamber Bushings.

Crank Pin Machines for Truing Up Worn Crank Pins, New Design. Accurate work.

Portable Valve Seat Facing Machine.

"Safety First" Requirements Satisfied. Send for Illustrated Bulletin "L"

E. J. ROOKSBY & CO.

1070 Hamilton St. Philadelphia, Pa.

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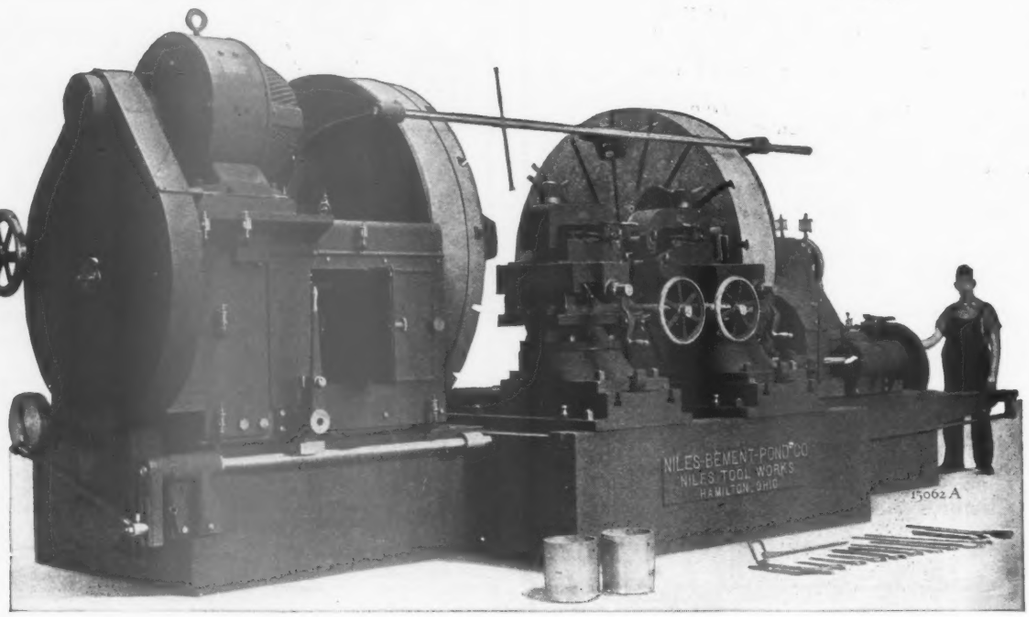
For Locomotive, Car and Railroad Repair Shops



This Driving Wheel Lathe is considerably heavier than any previous model and is especially designed for high production. It embodies several new and valuable features in addition to all our well known time and labor saving devices. The right hand headstock is equipped with a powerful pneumatic clamp and power traverse. The lathe is also equipped with pneumatic tool clamps and convenient calipering device.

We are in a position to furnish complete machine tool equipment for Locomotive and Car Shops, Railroad Repair Shops as well as General Machine Shops.

LATHES: From 9″ swing up to meet any requirements.
LATHES: Driving Wheel; 51″ to 90″ swing.
LATHES: Car Wheel.
LATHES: Axle.
WHEEL PRESSES: Capacities, 200 to 600 tons and to take wheels from 42″ to 90″.
CAR WHEEL BORING MACHINES, to take wheels up to 42″.
AXLE CENTERING AND CUTTING-OFF MACHINES.
WHEEL QUARTERING MACHINES.
PLANERS: From 30″ between housings up to meet any requirements.
BORING MILLS: 36″ swing up to meet any requirements.
SLOTTERS: 6″ to 92″ stroke.
DRILLING MACHINES, VERTICAL: 24″ to 60″.
DRILLING MACHINES, RADIAL: 4′, 5′, 6′, semi and full universal; also heavy duty type up to 10′.
DRILLING MACHINES, MULTIPLE SPINDLE: 2, 4 and 6 spindles, in variety of types.
MILLING MACHINES: Built in variety of types and sizes to suit customers' requirements.
SHAPERS: Traveling Head. Single and Double Head. 22″ and 26″ stroke.
HORIZONTAL BORING AND DRILLING MACHINES.
HORIZONTAL BORING, DRILLING AND MILLING MACHINES.
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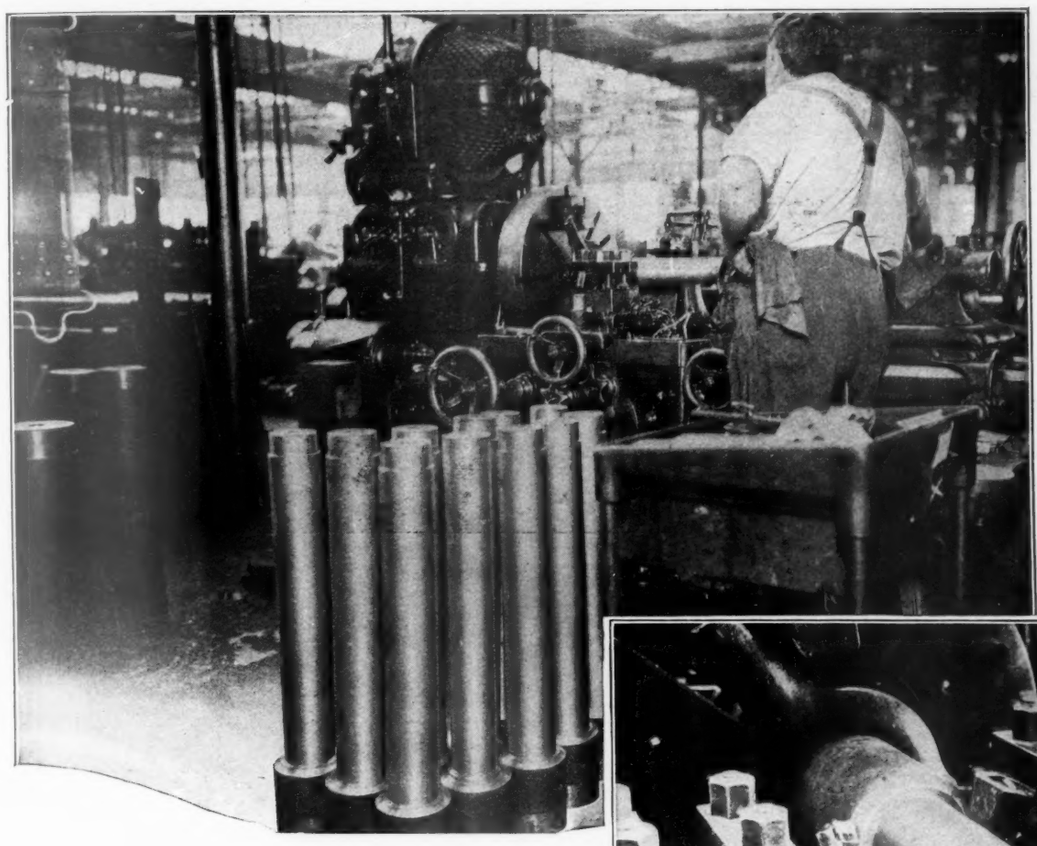
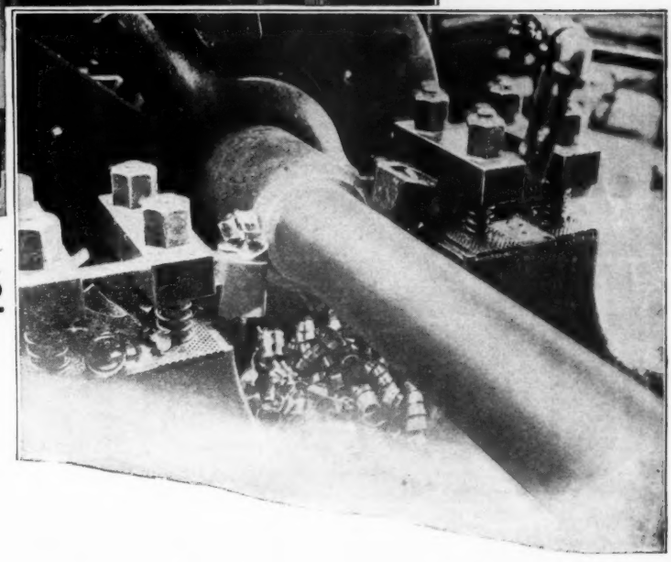




JUST 18 MINUTES

TO TURN ONE OF THESE

CHROME NICKEL MILLING MACHINE SPINDLES

If one of the largest Milling Machine builders in this country were able to reduce their cost by installing "American" Lathes, the chances are you can do the same thing.

Just think of this 24-inch "American" Lathe taking $\frac{11}{16}$ inch off of a Chrome Nickle Milling Machine Spindle in one cut.

That's the reason the big shops in this country are buying "American" Lathes. They're powerful, well built, accurate and up-to-date in every respect.

Write us immediately for our new catalogue.

THE AMERICAN TOOL WORKS COMPANY

Cincinnati, U. S. A.

LATHES PLANERS SHAPERS RADIALS

Why They Prefer
Lagonda Arch Tube Cleaners

This photograph was taken in the shops of one of the many large railroads which use Lagonda Arch Tube Cleaners as standard equipment. Several of these companies are using around a hundred Lagonda Cleaners for keeping arch tubes in shape.

In the above shop, this Lagonda Cleaner serves 45 engines—each engine washed out 4 times a month—175 wash-outs per month, to be exact.

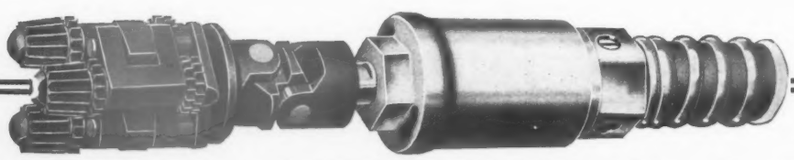
Under such severe service a Lagonda Cleaner has been in service ten years, the foreman tells us. Repair bill—$5.00. The cleaner is never out of order, always on the job. The men like it.

You can have the same kind of service by simply specifying LAGONDA Arch Tube Cleaners.

Bulletin W-3 sent on request.

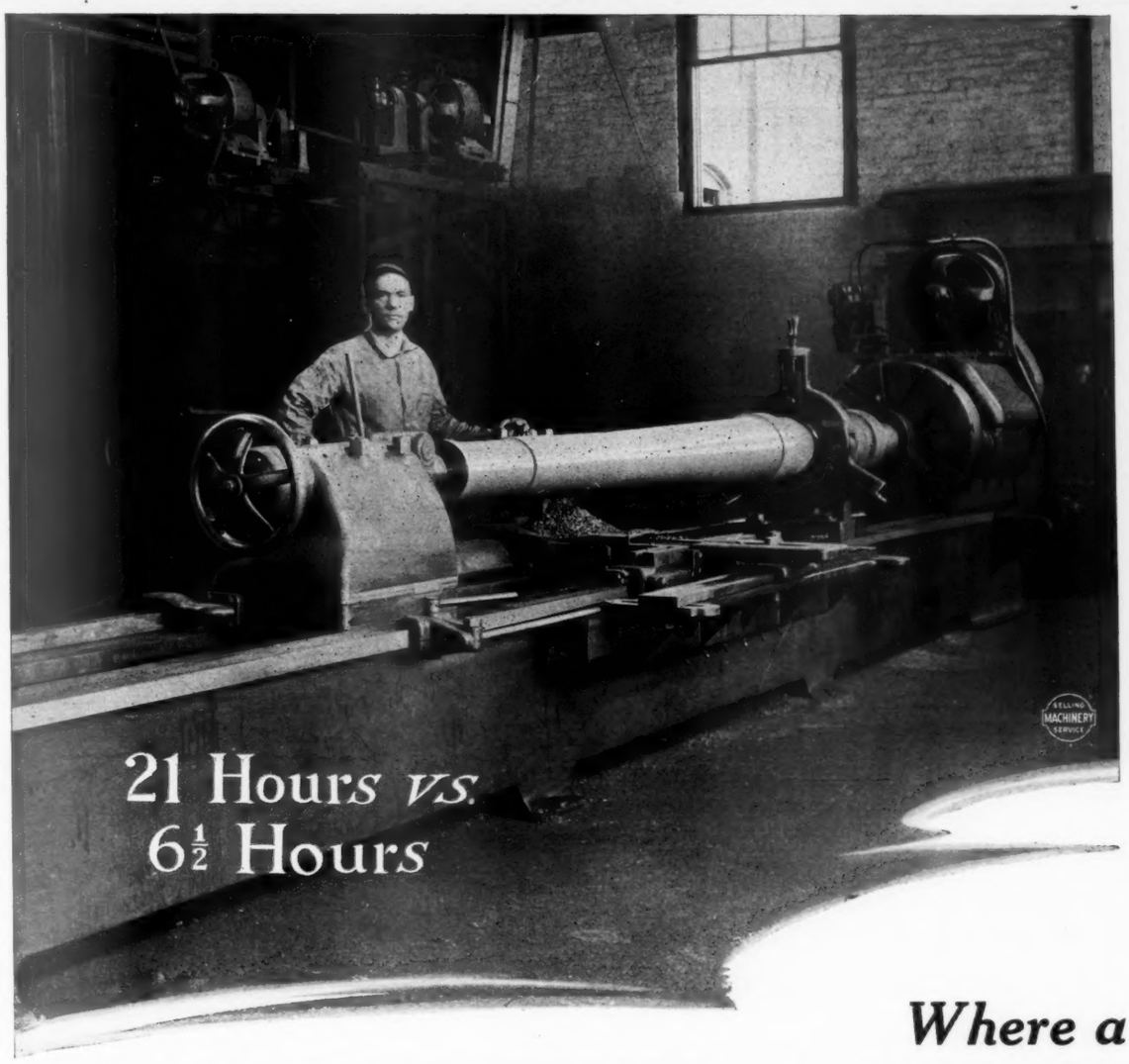
The Lagonda Mfg. Co.
SPRINGFIELD, OHIO.
FUEL SAVING SPECIALISTS
NEW YORK, BOSTON, PHILADELPHIA, ST LOUIS, CHICAGO, DETROIT, DENVER, DALLAS, SAN FRANCISCO, ST. PAUL, MONTREAL, LONDON

Makers of Lagonda Boiler Tube and Condenser Cleaners, Tube Cutters, Automatic Valves, Reseating Machines and Grease Extractors.



391

Lagonda Cleaner for standard 3" O. D. and 2⅝" I. D. Arch Tubes. Cleaners made for all sizes and types of tubes.



Where a

BRIDGEFORD LATHE

Saved 14½ Hours on a 21 Hour Job

Some time ago we furnished J. H. Horne Sons & Company, Lawrence, Mass., estimates of what a Bridgeford Lathe could do on big textile machine spindles. The figures looked good and we sold them this 32" x 28' machine. The spindles come to the lathe as castings from which considerable stock must be removed. There is a long taper and two or three irregular sections as well as straight portions to be turned. While the spindles vary in size and shape, an average job by former methods meant 21 hours of good hard work, including handling time and turning time. The first spindle put up to the newly installed "Bridgeford" came off the lathe in 6½ hours. And that is a good example of the Bridgeford pace.

Bridgeford Lathes are rigid, accurate machines, adapted for turning heavy rolls, big shafts, massive pinions and similar work, machines capable of pulling any cut the best high speed steel tools will take.

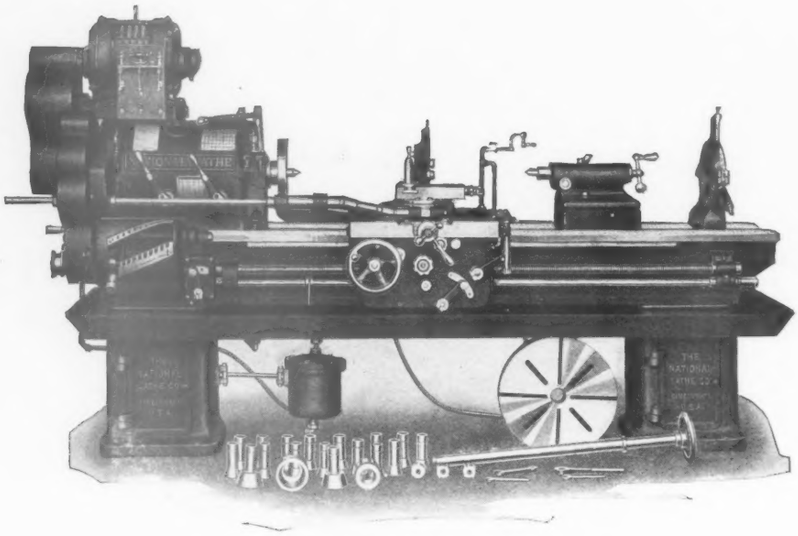
The harder the work, the stiffer the pace, the more you need Bridgeford Lathes.
Shall we send you our catalogue?

BRIDGEFORD MACHINE TOOL WORKS

151 WINTON ROAD MANUFACTURERS FOR HEAVY DUTY LATHES FOR MORE THAN 20 YEARS **ROCHESTER, N. Y.**

The National Tool Room Lathe

A Phenomenal Producer



18" High Duty Geared Head Tool Room Lathe

This lathe will double your output.

This lathe will produce at low cost.

This lathe will cut the time on the job.

This lathe is accurate, speedy, powerful, dependable.

This lathe is easily operated.

This lathe is designed and built for service and gives it.

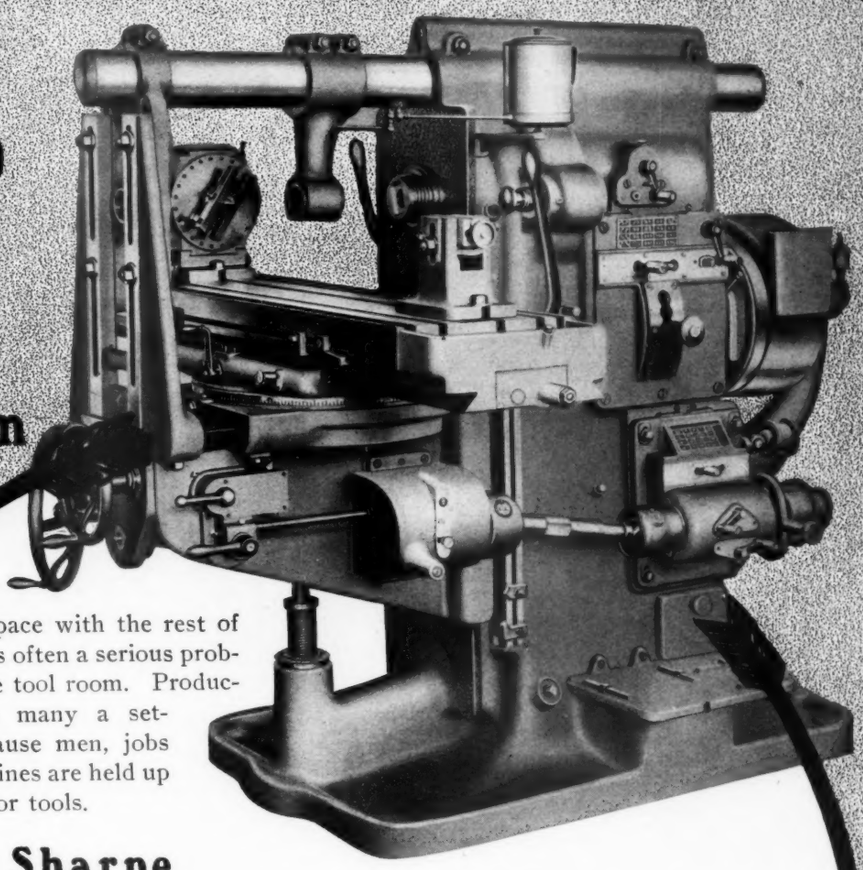
If this is not sufficient—write for more information. We will gladly send it.

The National Lathe Company

Manufacturers of Engine Lathes

CINCINNATI, OHIO

"SPEED UP" Your Tool Room



To keep pace with the rest of the shop is often a serious problem in the tool room. Production gets many a set-back because men, jobs and machines are held up waiting for tools.

Brown & Sharpe Universal Milling Machines

because of their versatility, ease of set-up and handiness in operation are helping many tool room foremen to keep their shops supplied with tools **when they're needed.** Accurate enough for the finest tool work, yet rugged and powerful, they fulfill the requirements of the railroad shop tool room in a decidedly profitable way.

Why You Should

Specify B & S Machines

70% **or more of universal milling depends for success on the Spiral Head**

And right there we find reason enough for specifying B & S Universal Milling Machines because the B & S Spiral Head is especially capable of taking care of that "seventy per cent."

A few of its many features:

Index worm is carefully cut, hardened and ground to insure accuracy.

The graduated index sector allows the arms to be set to include any number of holes without counting.

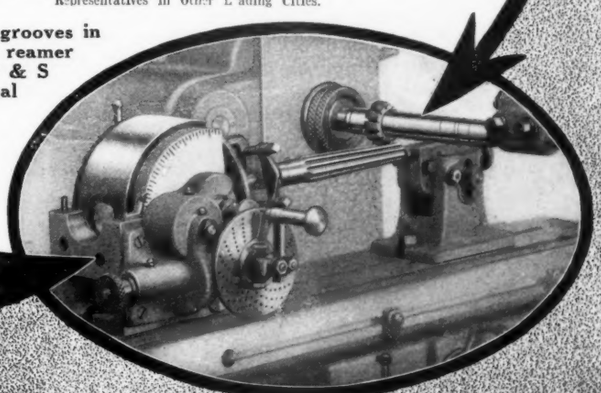
The crank, having radial and circumferential adjustment allows pin to be moved to nearest hole without disturbing the work or the work to be adjusted without moving the pin.

Send TODAY for literature covering these machines and catalog.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

Offices: New York, N. Y., 20 Vesey St. Philadelphia, Pa., 1103-1105 Liberty Bldg. Chicago, Ill., 626-630 Washington Blvd. Rochester, N. Y., 415 Chamber of Commerce Bldg. Syracuse, N. Y., Room 419, University Block. Pittsburgh, Pa., 2538 Henry W. Oliver Bldg.
Representatives in Other Leading Cities.

Milling grooves in a taper reamer on a B & S Universal



The DIAMOND Guide Bar Grinder

This Machine Proved Its Worth In a Middle-Western Railway Shop

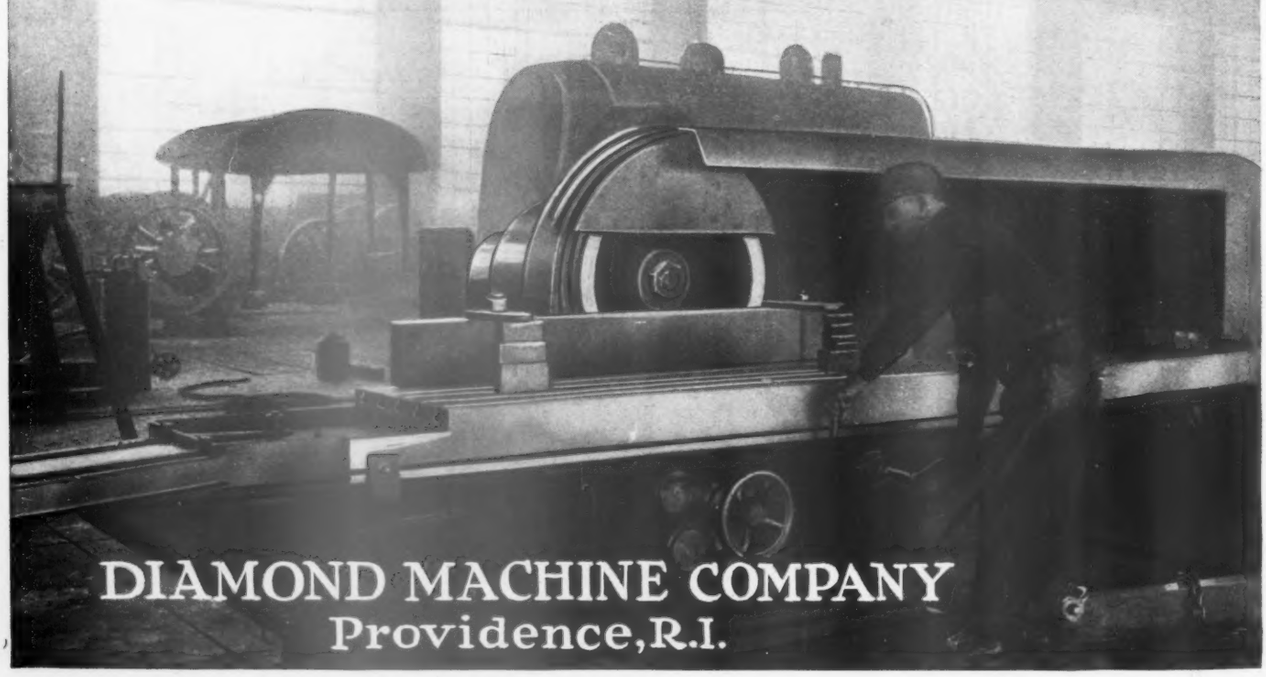
The Diamond Guide Bar Grinder was installed in April, 1913, in a shop in the middle west. Previous to its installation all guide bars were finish surfaced by planing, but this work was immediately transferred to the grinder. The results were highly gratifying, and since then all guide bar surfacing has been done on this machine.

The records in this shop, as in others, show that grinding is superior to planing: It is more rapid, the finish is better, and a first class machinist is not necessary for the operation of the machine. Also, in cases of hardened parts, grinding is a necessity.

In all shops where the Diamond Guide Bar Grinding Machine has been installed, the superiority of grinding in efficiency and economy on many other plane facing operations such as slide valves, brackets, etc., is unquestioned.

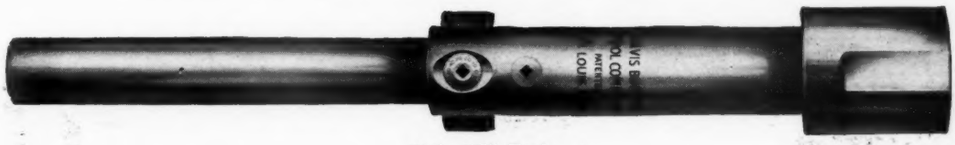
Why not include a DIAMOND in your next machine tool requisition?

Full particulars will be sent on request.



DIAMOND MACHINE COMPANY
Providence, R.I.

95% OF ALL RAILROAD SHOPS ARE OPERATING WITH DAVIS EXPANSION BORING TOOLS



Style "E" Tool for Turret Lathes

Style "V" Tool for Turret Lathes and Turret Boring Mills

Superiority—

The adaptability and uniform performance of DAVIS EXPANSION BORING TOOLS in any metal-boring operations is convincing evidence of their superiority.

Boring costs have been reduced from 25% to 50%, absolute accuracy has been maintained, and the greatest possible production obtained with the use of our tools.

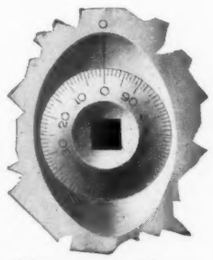
Equip your Turret Lathes, Turret Boring Mills, Drill Presses and any other machines that bore with IMPROVED DAVIS EXPANSION BORING TOOLS, and achieve similar results.

Descriptive circular telling how to save from 25% to 50% in boring costs will be sent on request.

Style "O" Tool for General Manufacturing Work

THE real feature of DAVIS EXPANSION BORING TOOLS is the practical method of cutter expansion.

The micrometer adjustment for expanding cutters to compensate for wear, permits the maintenance of any size within range of expansion, with absolute accuracy.



Micrometer Adjustment for Expanding Cutters

Style "E" Tool

The productive tool for Turret Lathe. Pilot is hardened and ground and has oil grooves.

Style "V" Tool

Specially adapted for straight and cylinder boring. Style "V" tool can be used on Turret Lathes and Turret Boring Mills.

Style "O" Tool

For any miscellaneous boring or for general manufacture, Style "O" tool is really indispensable. Has a standard thread in shank and can be readily applied to any ordinary arbor.

We Specialize in the Exclusive Manufacture of Expansion Boring Tools and Cutters.

Address DEPT. RC.

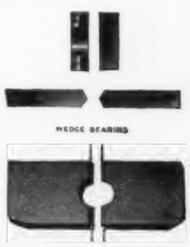
Davis Boring Tool Co.

Incorporated

St. Louis, Mo., U. S. A.

MAXIMUM production, greater accuracy, and decreased cutter costs are all assured with the exclusive use of DAVIS CUTTERS with DAVIS EXPANSION BORING TOOLS.

Davis Cutters are correctly tempered and ground and cost less than any which could be produced in your own plant.



Davis Expanding Cutters

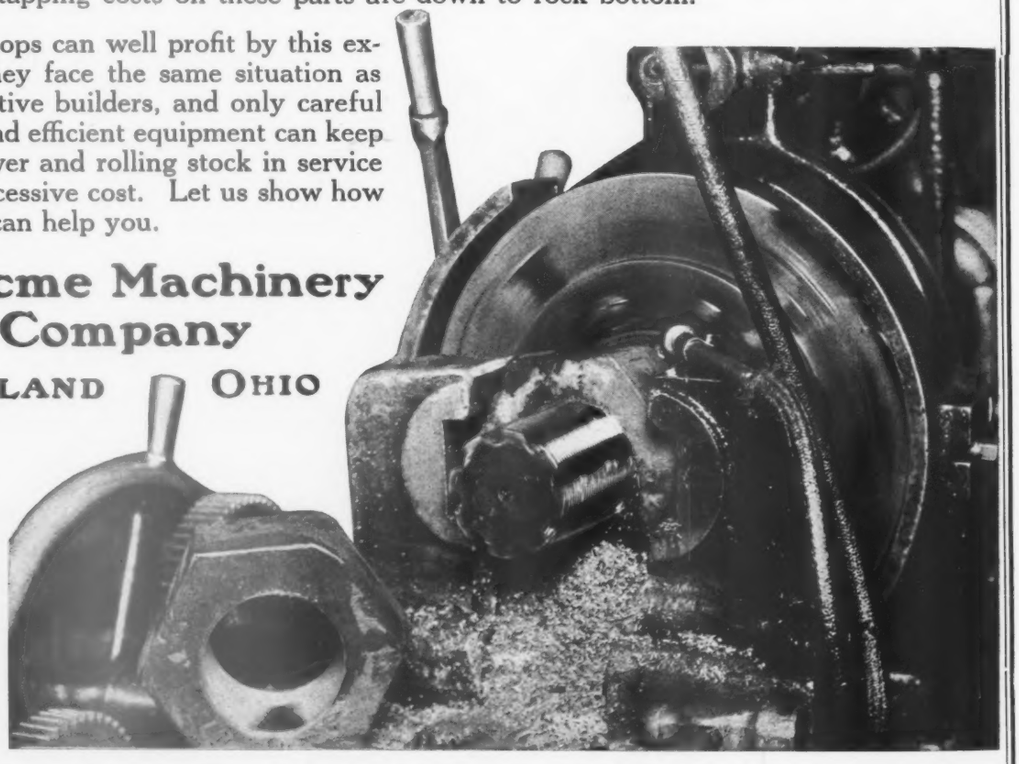
Cutting Tapping Costs With an Acme

In the face of ever rising material and labor costs, locomotive builders are planning work with extreme forethought. As far as possible, every job is done in the most efficient way on the most efficient machine. In one plant, four inch piston nuts are among the many jobs that fall to the lot of the 5″ Acme Bolt Cutter, with the result that tapping costs on these parts are down to rock bottom.

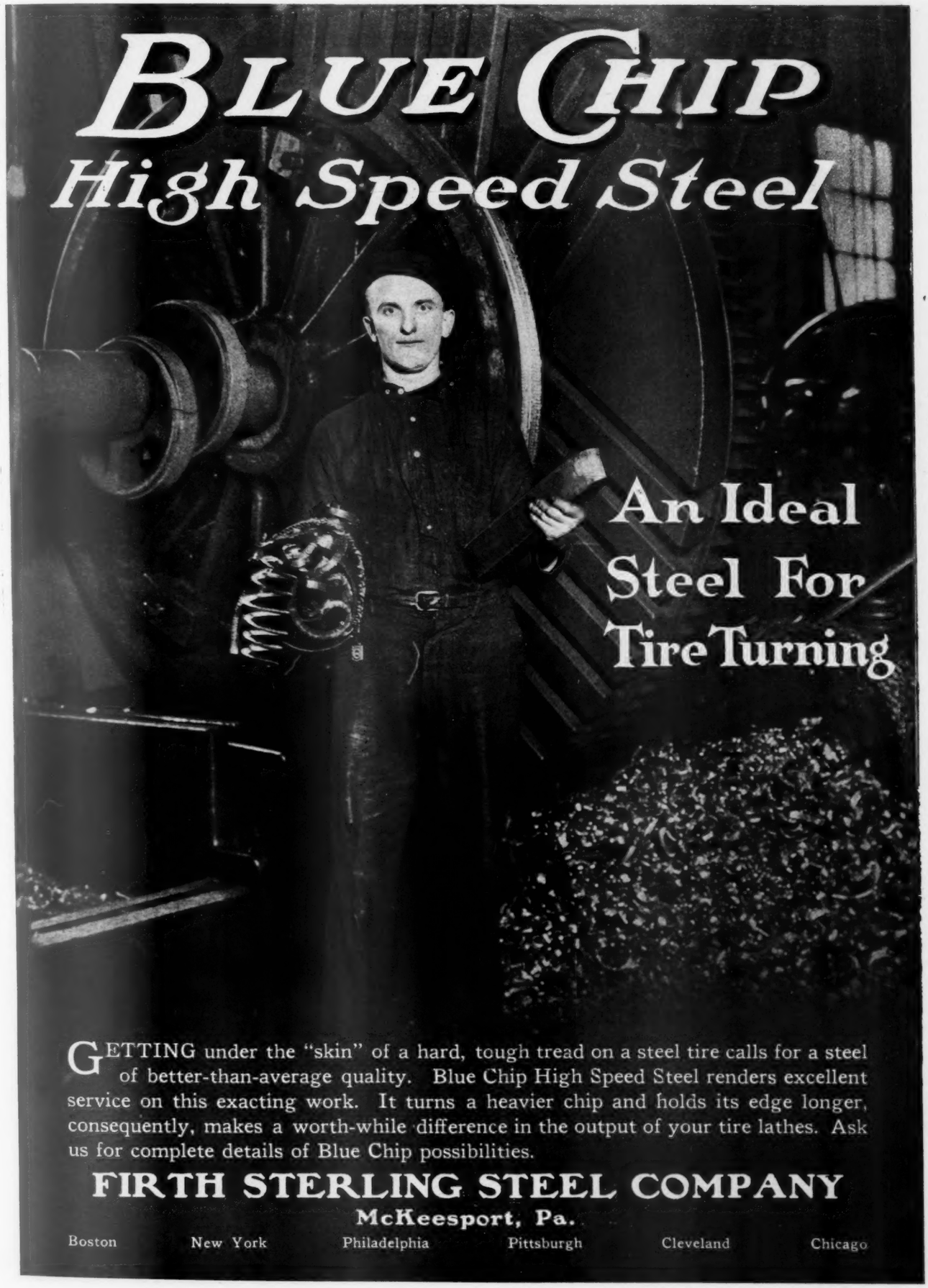
Railroad shops can well profit by this example. They face the same situation as the locomotive builders, and only careful planning and efficient equipment can keep motive power and rolling stock in service without excessive cost. Let us show how the Acme can help you.

The Acme Machinery Company

CLEVELAND OHIO



We make a full line of bolt cutting, tapping, and forging machinery. Complete Acme catalog on request.



GETTING under the "skin" of a hard, tough tread on a steel tire calls for a steel of better-than-average quality. Blue Chip High Speed Steel renders excellent service on this exacting work. It turns a heavier chip and holds its edge longer, consequently, makes a worth-while difference in the output of your tire lathes. Ask us for complete details of Blue Chip possibilities.

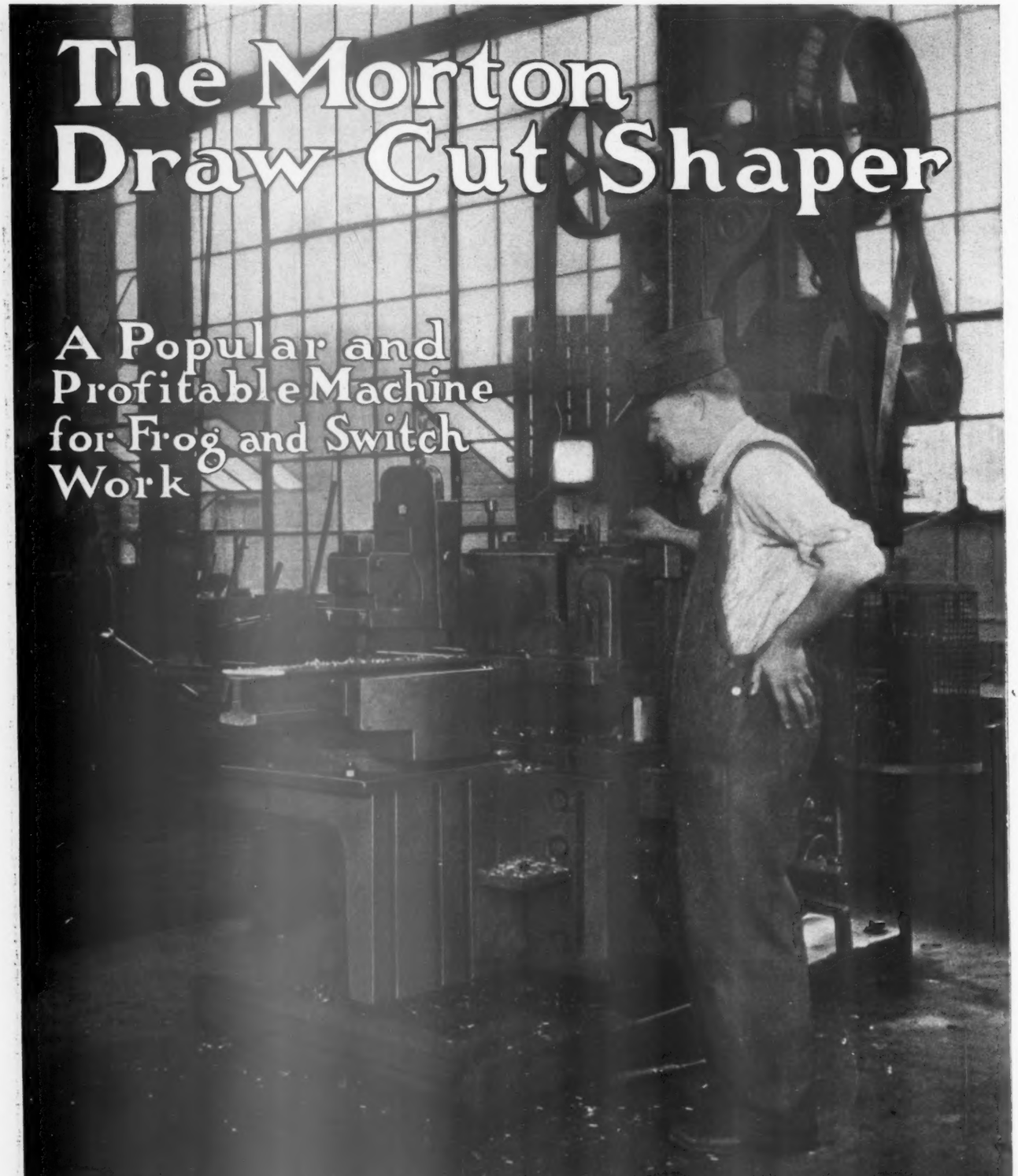
FIRTH STERLING STEEL COMPANY

McKeesport, Pa.

Boston New York Philadelphia Pittsburgh Cleveland Chicago

The Morton Draw Cut Shaper

A Popular and Profitable Machine for Frog and Switch Work



MUCH of the frog and switch work of one of the Western roads is handled on this Morton Draw Cut Shaper—in fact, this machine does very little else, so busy is it kept on this particular work. The Morton draw cut permits heavy cuts and coarse feeds in the tough rails without chatter or vibration. It follows as a matter of course that the output is high and costs correspondingly low. Two other "Mortons" in the same shop are keeping down the cost of machining crown brasses, shoes and wedges and similar work. Ask us for Bulletins 8 and 10.

Morton Mfg Co. Muskegon Heights, Mich.

Starrett Hack-Saws

Not Yet!

Don't be satisfied to select the Starrett Hack Saw until you can also select a numbered Starrett. While it is true that

Starrett Hack-Saws

are unexcelled—made of the best material and all that—it's equally true that for economy in metal cutting, the saw must be suited to the job; in short, a "Starrett" of the right number.

The number on a Starrett Hack Saw shows what it should be used for. What the numbers mean and how they are used to spell economy is explained in Catalog No. 21GF.

STARRETT HACK SAWS CUT QUICKER LAST LONGER

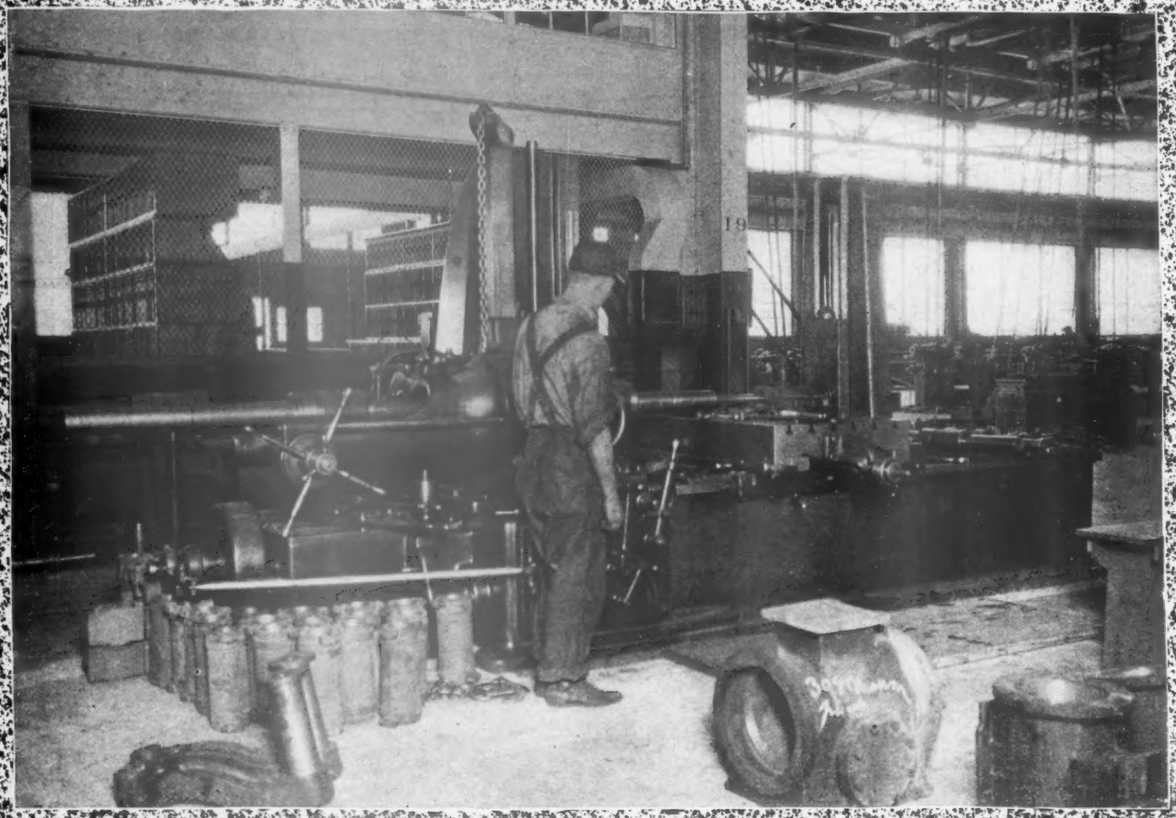
The L. S. Starrett Co.

The World's Greatest Toolmakers

ATHOL, MASS.

NEW YORK LONDON CHICAGO

42-745



Lucas Precision Milling, Drilling and Boring Machine

Versatility That Means Economy

EIGHTEEN months ago this No. 32 "Lucas" was shipped to the shops of a big Western road. Today, the foreman regards it as "the most versatile machine in the shop—and the busiest one, too."

When the camera clicked, the machine was boring a steam chest for a pump. On the floor lay other "Lucas" jobs—rocker shafts, vacuum pump cylinders and rocker box bushings. All were machined with ease, accuracy and speed. Milling cross head shoes, truck boxes and grease cellars, boring and facing throttle valve brasses, valve chamber bushings and machining miscellaneous castings, dies, etc., are a few of the typical jobs handled on this versatile and adaptable machine. On work requiring milling, drilling and boring operations, there's a sure way to cut costs—the "Lucas" way. It costs you nothing to get the complete story. Write us today.

Lucas Machine Tool Co. Cleveland, Ohio

A Crosshead Complete in 3½ hrs. If it's Done on a

BULLARD

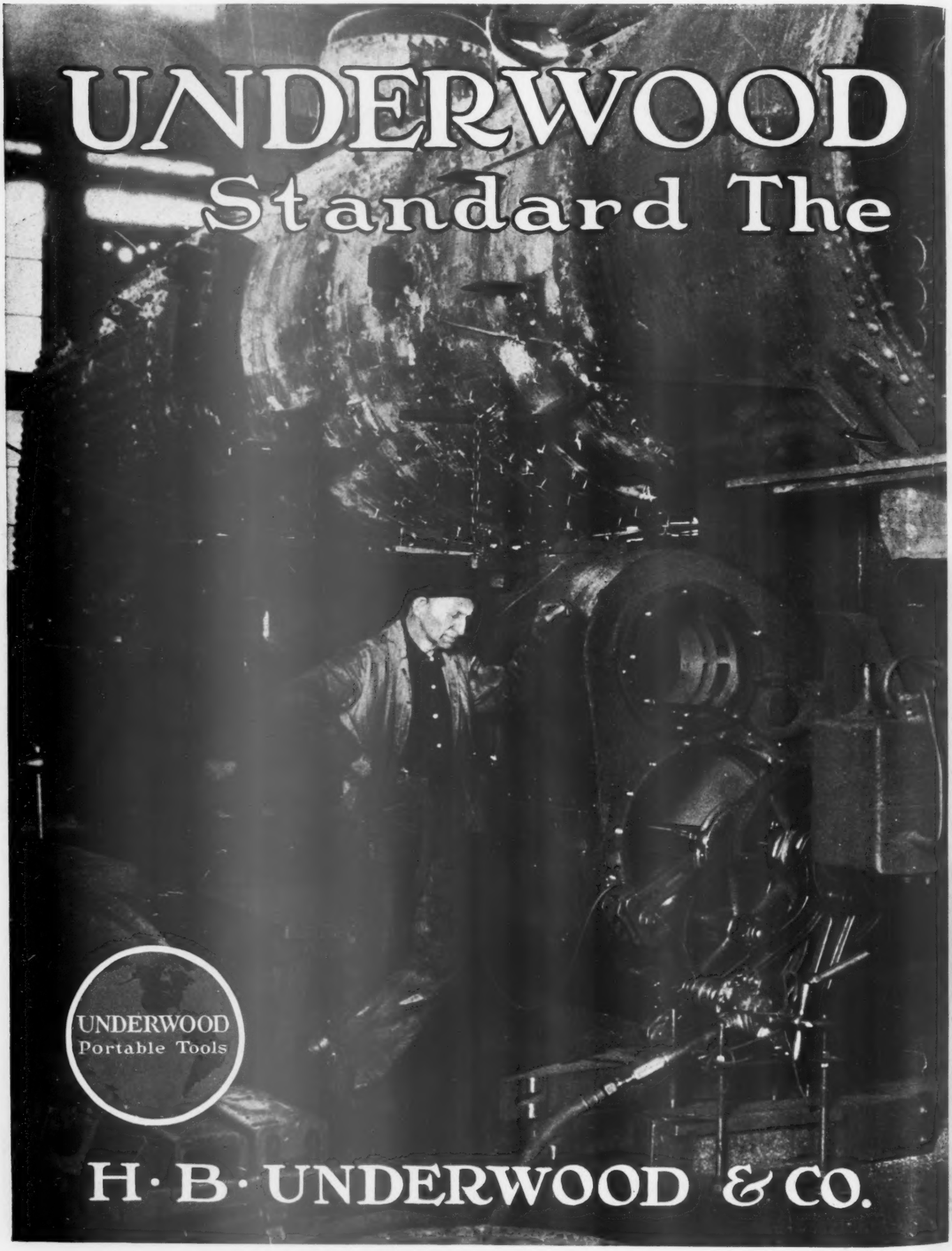
A cast steel crosshead—bored for piston rod fit—faced and turned on the boss bored for wrist pin and faced on side—is an easy 3½-hour job on a Bullard Vertical Turret Lathe. It's good time, too—the sort of a performance that means much in these high-pressure times, when overworked motive power requires frequent and speedy repairs.

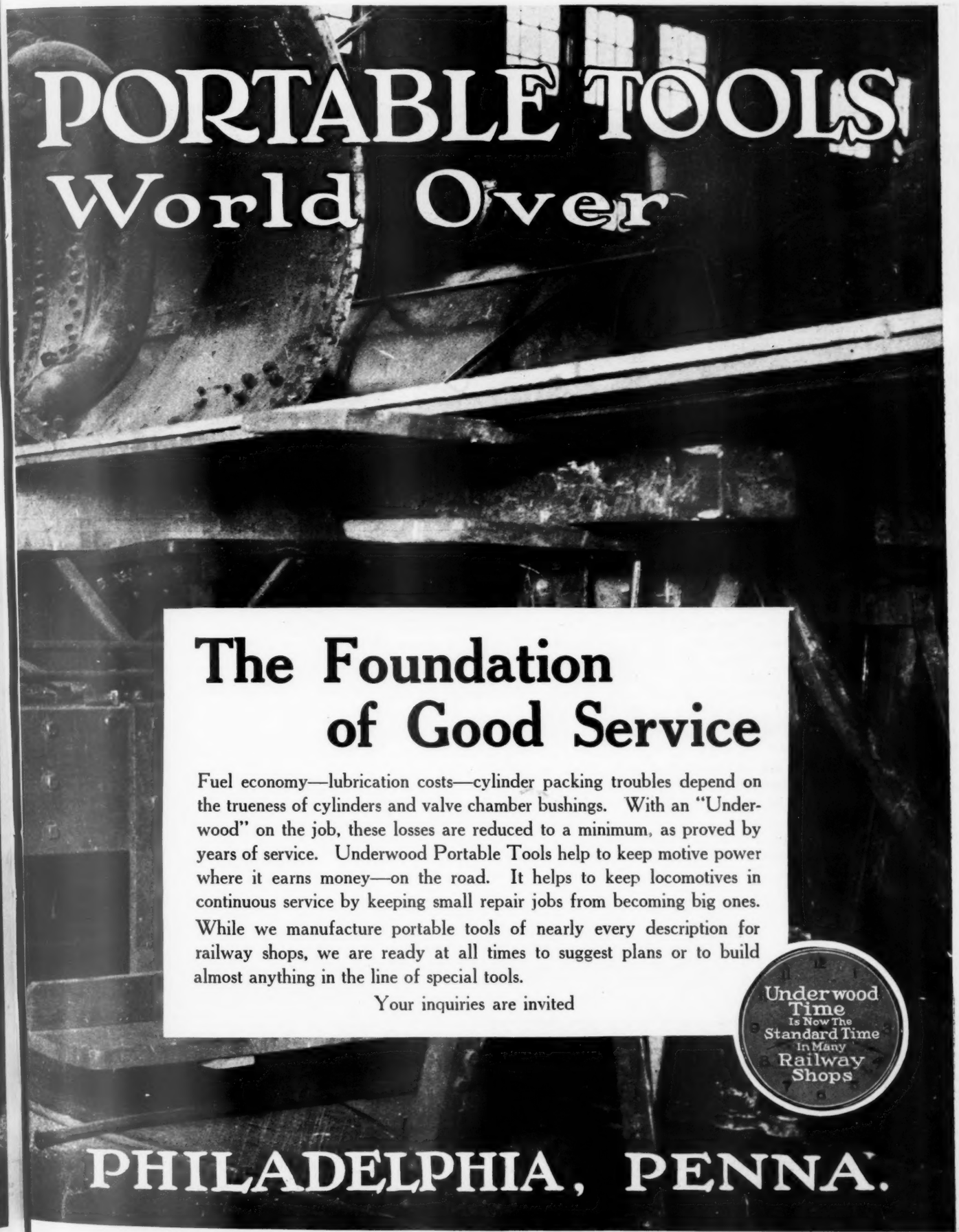
This Winter will be the supreme test of the American Railroad Shop. The shops which number Bullard Vertical Turret Lathes among their equipment have production assets that will count heavily in keeping engines on the road when hard weather and heavy traffic combine to make the shop burden severe.

Is your shop equipped with "Bullards"? If not, we can give you good reasons why it should. Ask us for them.

Bullard Machine Tool Company

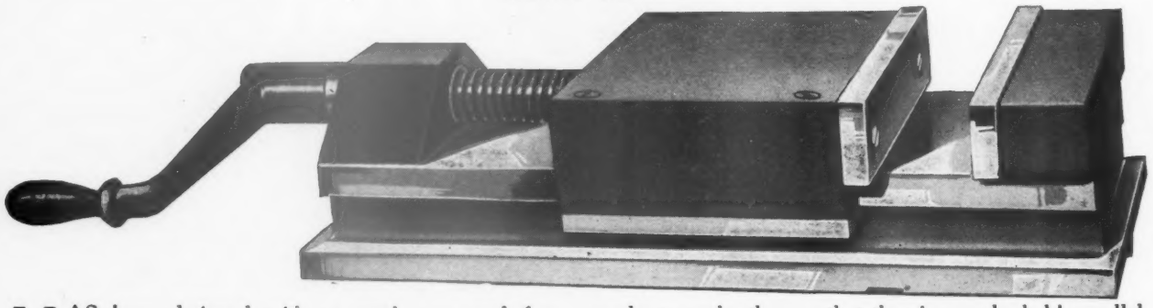
Bridgeport, Connecticut


UNDERWOOD
Standard The
UNDERWOOD
Portable Tools
H·B·UNDERWOOD & CO.


PORTABLE TOOLS
World Over
The Foundation
of Good Service
Fuel economy—lubrication costs—cylinder packing troubles depend on the trueness of cylinders and valve chamber bushings. With an "Underwood" on the job, these losses are reduced to a minimum, as proved by years of service. Underwood Portable Tools help to keep motive power where it earns money—on the road. It helps to keep locomotives in continuous service by keeping small repair jobs from becoming big ones. While we manufacture portable tools of nearly every description for railway shops, we are ready at all times to suggest plans or to build almost anything in the line of special tools.
Your inquiries are invited
Underwood Time Is Now The Standard Time In Many Railway Shops
PHILADELPHIA, PENNA.

The Cleveland Milling Machine Co.

Plain Vise



HAS been designed with as much care and forethought as we have given our milling machines, cutters, and other products. There are good features in all vises, and bad features in some. When designing this vise, we took into consideration all the difficulties encountered, because of the shortcomings and faulty construction of vises which had come to our attention, and have endeavored, to the best of our ability, to eliminate these objectionable features.

It is a fact that the milling machine vise in many instances is expected to take the place of a jig, or fixture, and becomes quite an efficient addition to the milling machine, especially when used in pairs, so that one vise can be loaded or unloaded while the cutters are working on the piece, or pieces to be milled, in the other vise. Realizing this, we have made the tongue slot, on all vises, an exact distance from the face of the solid jaw. This feature is taken care of by efficient jigs for milling these slots.

All milling machine vises should be made as low as possible, without sacrificing strength and the facilities for clamping. This we have accomplished by having a cast, and machine finished flange on all four edges of the vise, thus allowing it to be clamped in any position on the table.

The jaws are of steel and can readily be removed for occasionally increasing the range, or inserting special jaws for holding pieces of irregular shape.

The ways of the vise are solid, giving the base greater strength, and the construction of block and gibbs such that they wipe the ways free of chips and foreign matter.

The movable jaw is made of ample thickness to allow for as large a diameter of screw as is consistent with the height of the vise. Tongue slots are milled at right angles to each other, so that the vise can be held parallel, or at right angles with the spindle.

It is also a fact that nearly all vises break diagonally from the corner of the solid jaw to the base, or on a diagonal line from the screw bearing to the base. We find that in casting these bases, this part of the vise has hitherto been solid, and has contained a larger amount of metal; the shrinkage, therefore, being greater at both ends, causes the metal there to be spongy and as this is where the greatest amount of stress comes, the castings usually break at these points. To overcome this trouble, we have set cores in both ends, as shown in sectional view below. These cores allow an even distribution of metal all around, eliminating shrinkage, and makes for stronger construction throughout.

The movable jaw is gibbed around the outside. This design eliminates the objectionable feature of having slots cut in the base of the vise for clamping the gibbs directly underneath. These gibbs, however, do not interfere in any way with the clamping of the vise onto the milling machine table.

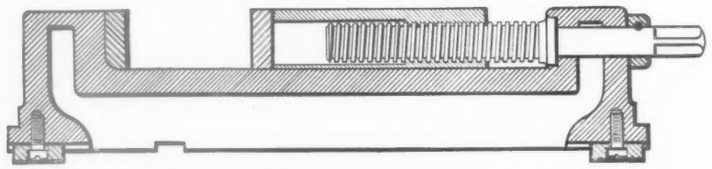
Depth of jaws 1½".
Width of jaws 6".
Open with steel jaws 4⅜".
Open without steel jaws 5⅜".

The regular equipment furnished with this vise is as follows:

One pair of clamps and bolts.
One crank handle.
Hardened and ground tongues.

Since the demand for this vise has been very great, we have arranged to keep them in stock, for immediate delivery.

Price on Application.



The Cleveland Milling Machine Co.

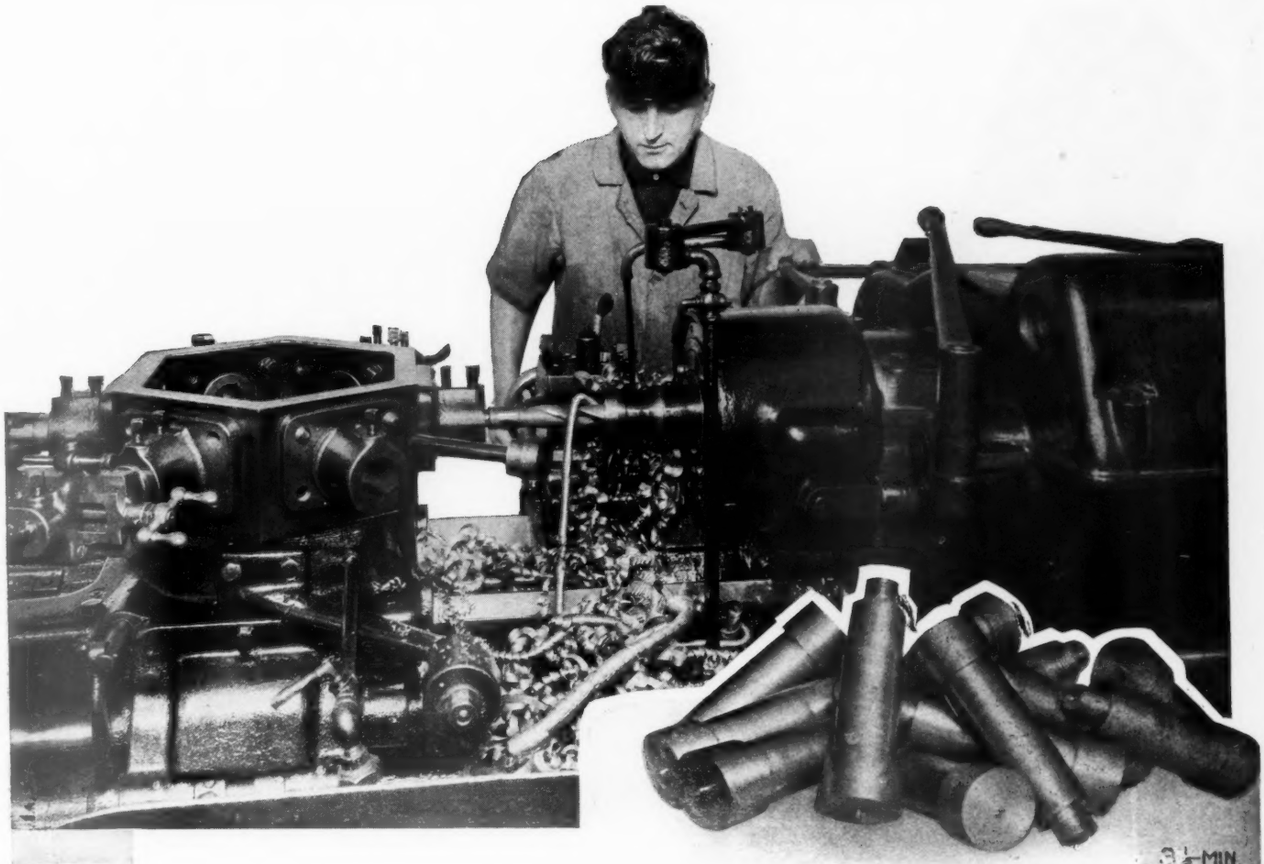
CLEVELAND, OHIO.

Milling Cutters **Milling Machines** **Relieving Machines**

DALE-BREWSTER MACHINERY COMPANY, INC.
547 W. Washington Blvd., Chicago, Ill.
New York Office, 30 Church Street, New York City

Cutters carried in stock by our agents

D. NAST MACHINERY COMPANY
Bourse Bldg., Philadelphia, Pa.
4 East German Street,, Baltimore, Md.



Even for Odd Jobs
The "Hollow-Hex" is Best

Because of the rapidity with which it can be set up, the quick interchangeability of its tools, the simultaneous operation of turret and carriage, the ready application of its power, plus its exceptional precision, small jobs which are costly to produce on the slower engine lathe can be inexpensively produced singly and often very profitably in lots of six or more on the

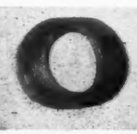
Universal Hollow-Hexagon Turret Lathes

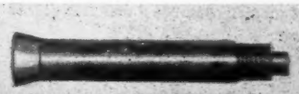
Our engineering department is at your service. It is helping many plants to save time and money. Consult it freely. Send blueprints, rough and finished samples.

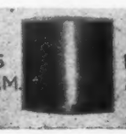
THE WARNER & SWASEY COMPANY
CLEVELAND, OHIO

New York Office: Singer Building
Boston Office: Oliver Building
Buffalo Office: Iroquois Building
Detroit Office: Ford Building

Chicago Office and Salesrooms: 618-622 Washington Boulevard







The "Gun" Tap "It Shears"

Tapping Holes At 60 ft. Per Minute

That's the kind of record that the "Gun" Tap turns off nonchalantly.

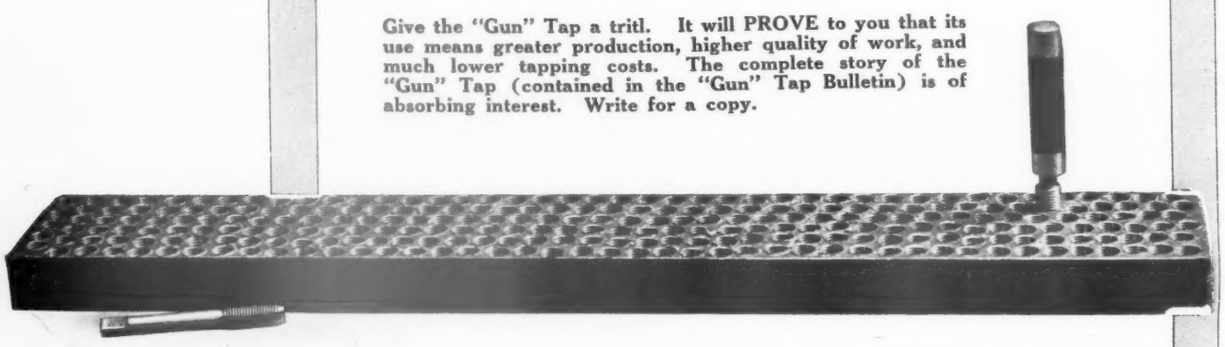
The piece on which this test was made is shown below. In one inch open-hearth steel we tapped 257 holes, 3/8 in. S.A.E., at 60 ft. per minute.

After this hard driving the "Gun" Tap did not show any wear. The gage fitted the first and last holes tapped with no noticeable difference.

The "Gun" Tap is the famous tap that "wears out before it breaks." Users everywhere are getting wonderful results from it. It cuts true to size in any and all materials.

The "Gun" Tap is patented and manufactured exclusively by the Greenfield Tap and Die Corporation.

Give the "Gun" Tap a tritl. It will PROVE to you that its use means greater production, higher quality of work, and much lower tapping costs. The complete story of the "Gun" Tap (contained in the "Gun" Tap Bulletin) is of absorbing interest. Write for a copy.



Greenfield Tap and Die Corporation

Greenfield, Massachusetts

New York, 28 Warren St. Chicago, 13 S. Clinton St. London, 149 Queen Victoria St.
Canadian Factory, Wells Brothers Co. of Canada, Ltd., Galt, Ont.

SHOPS THAT MOVE "DOUBLE QUICK" USE

THE ROULSTED TWENTY

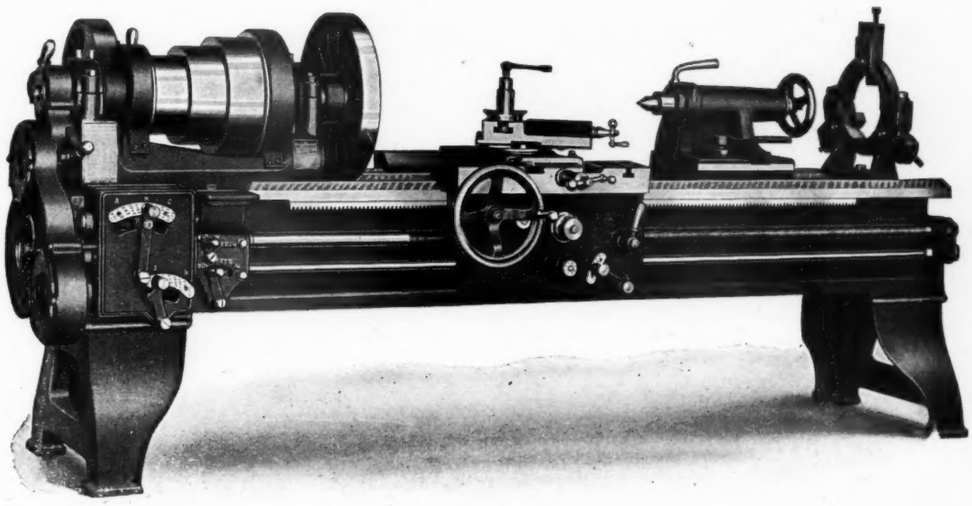
PRONOUNCED ROLL-STED

SHOP STATEMENTS:

Does more work than any other lathe in this shop!

A Machine you can drive to the limit!

Does any job that comes along!



In the shops where things move "double quick" you will always find THE ROULSTED TWENTY on the job. Whether it is on marine engines, valve bodies, gear blanks, pulleys, piston rods, cylinders, or anything that happens to come along—you will find it doing the work without a hitch.

Let us send you circular and views of this lathe "in action."

Hill, Clarke & Company, Inc.

The Machinery Merchants

Boston, Mass.
156 Oliver Street

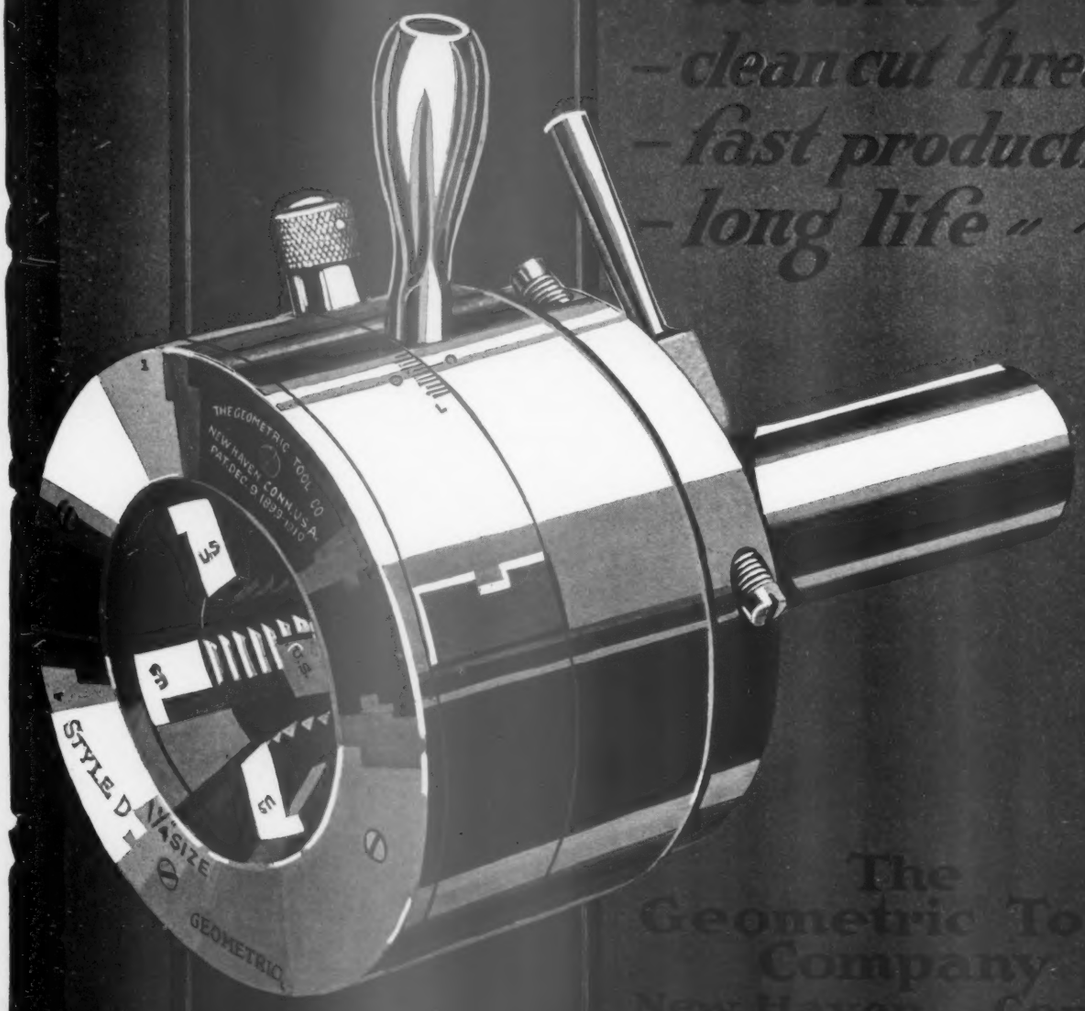
New York City
136 Cedar Street

GEOMETRIC

SELF OPENING DIE HEAD

Specify Them for

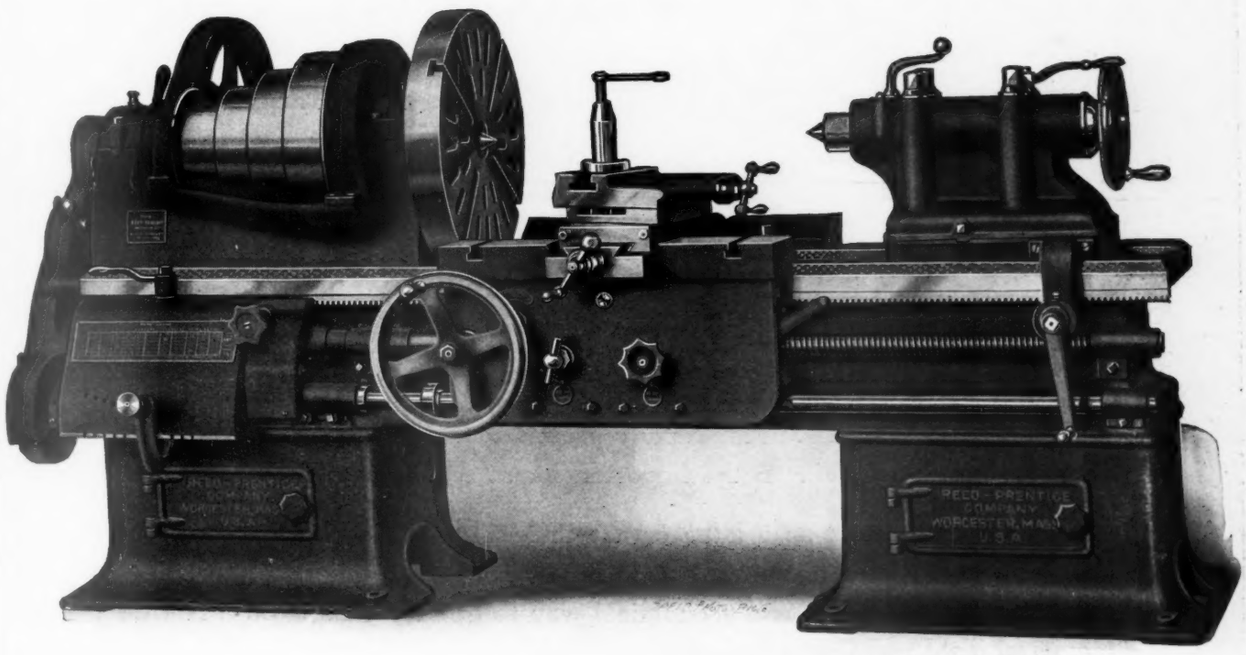
– accuracy " "
– clean cut threads
– fast production
– long life " " "



The Geometric Tool Company
New Haven, Conn.
CHICAGO STORE
316 West Washington Blvd.

REED-PRENTICE COMPANY

WORCESTER R-P MASS. U.S.A.



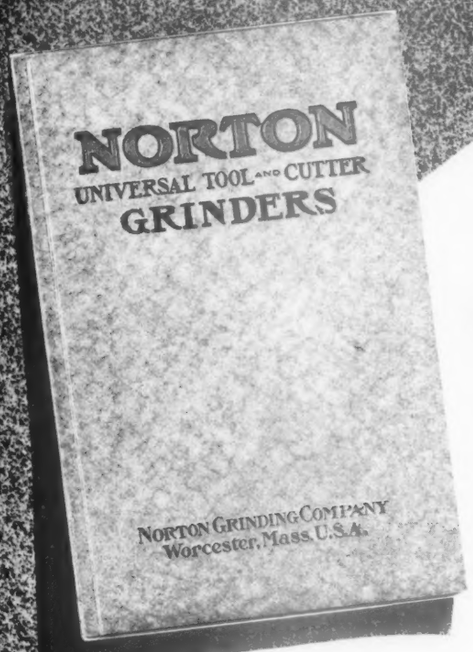
BETTER WORK—MORE CONVENIENTLY

THROUGHOUT THE YEARS THAT "REED" LATHES HAVE BEEN BUILT, THE IDEA OF ITS SPONSORS HAS BEEN TO MAKE IT ONE OF THE BEST TOOLS MONEY COULD BUY.

ITS REPUTATION BEARS TESTIMONY OF THE ATTAINMENT OF THIS IDEAL

A FEW OF VARIOUS SIZES CAN BE HAD AT ONCE.

MANNING, MAXWELL & MOORE, INC., NEW YORK
ALLIED MACHINERY CO. OF AMERICA, PARIS
FENWICK FRERES, PARIS
CANADIAN FAIRBANKS MORSE CO., LTD.



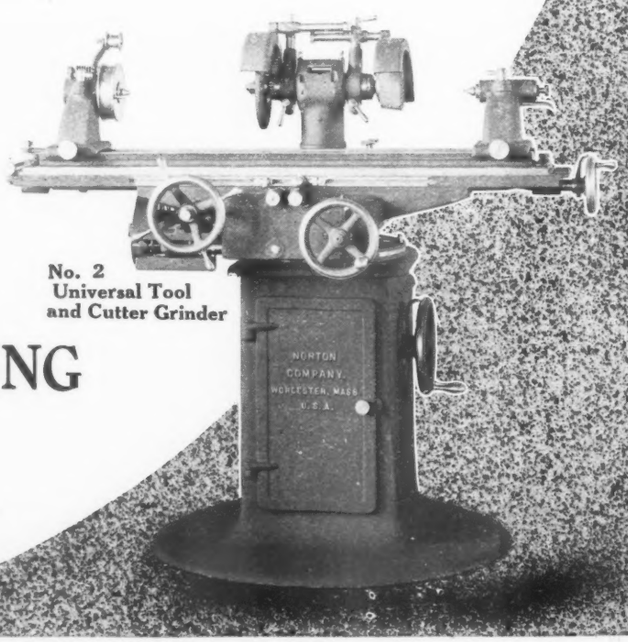
Keep Your Tools and Cutters Sharp

—they will cut faster
—they will wear longer
—they will use less power
—they will do better work

A dull tool is almost as bad a handicap on good work and fast production as an inefficient machine. An improperly ground tool is even worse. Too great emphasis cannot be laid on the importance and economy of well kept tools.

You can grind cutters on a lathe or a cylindrical grinding machine, but it is slow and costly and it ties up a machine that might be more profitably employed. The efficient and economical way to grind cutters is on a **Norton Universal Tool** and **Cutter Grinder.**

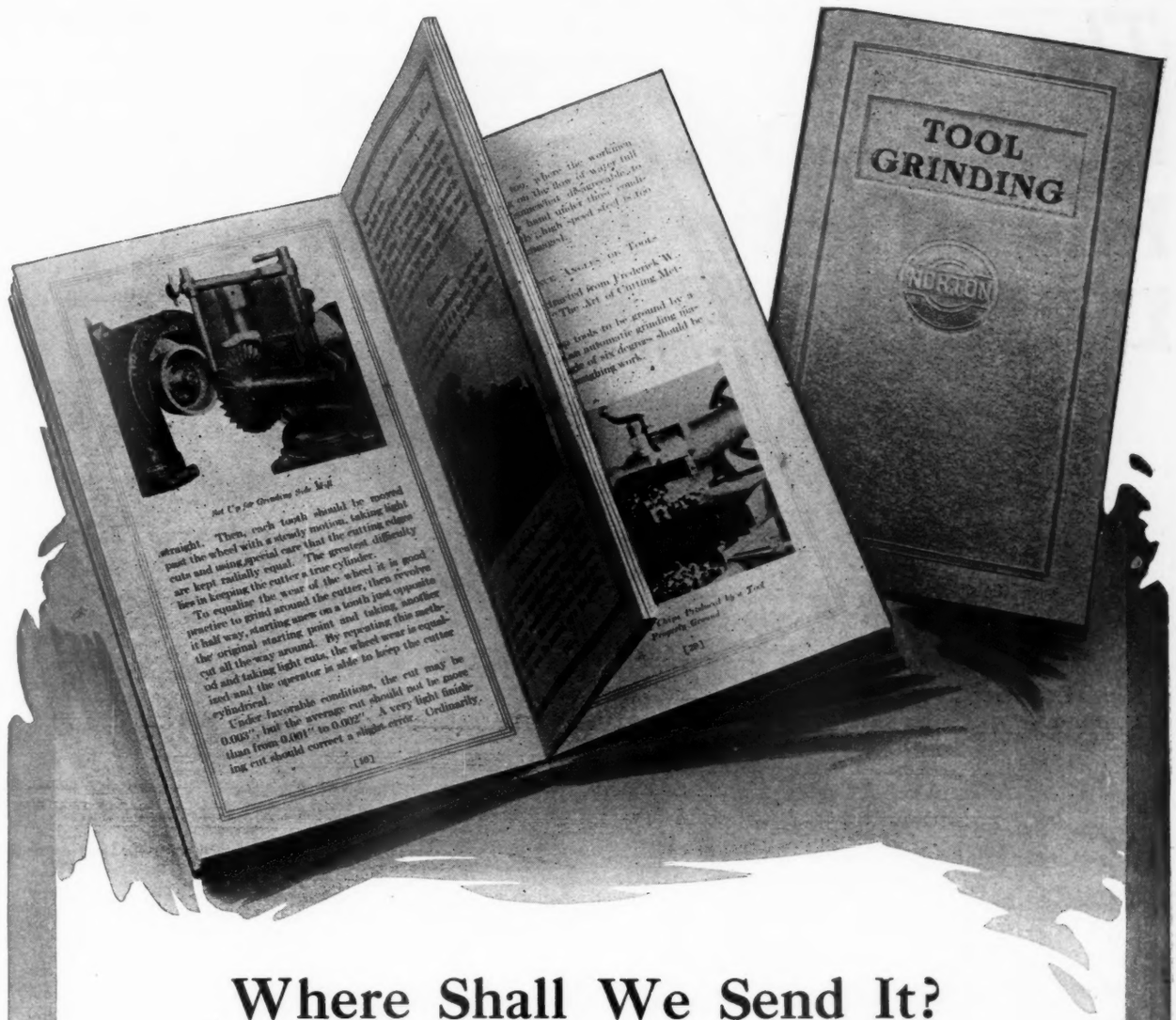
This machine will grind cutters, reamers, end mills, counter-bores, taps, saws, etc., and in addition can be adapted to straight and taper cylindrical grinding, surface and internal grinding. This machine can be kept profitably busy in **your** tool-room—it will pay for itself in short order. Write for the catalog describing it in detail.



No. 2 Universal Tool and Cutter Grinder

NORTON GRINDING COMPANY

WORCESTER MASS.



Where Shall We Send It?

Every Tool Room Man should have this booklet.

There are 40 pages full of good information on tool room grinding—cutters, reamers, drills, taps and dies, lathe and planer tools.

It's yours for the asking. Just send us your address and a copy of this valuable little booklet will be mailed FREE of charge without any obligation to you.

NORTON COMPANY
Worcester, Mass.

Use coupon, letter or postcard—
Ask for Booklet 835-E

Norton Company, Worcester, Mass.

Please mail my copy of Booklet 835-E to the following address:

Name .....

Street and Number.....

City or Town.....

State .....

The Foote-Burt High-Duty DRILL

(Compound Table)

Built Both 24 and 36″ Swings

Has a capacity for high-speed drilling up to 3 inches, in solid steel, feeding to the full capacity of the cutting edge.

All speed and feed changes are accomplished through a new quick change gear device of our own design. The levers for stopping the machine and for changing speeds and feeds are conveniently located and are within easy reach of the operator at all times.

Single Belt Drive

No Shifting Of Belts Required

All Levers Within Easy Reach

THE RIGID DESIGN, the long spindle bearings and the perfect ease with which the operator controls the machine, make the Foote-Burt Drills particularly suited to the classes of work where extreme accuracy is required. The Compound Table is an extra attachment, consisting of an entirely new knee for this purpose, the advantages of which are obvious.

Send for Circulars of High Duty Drills

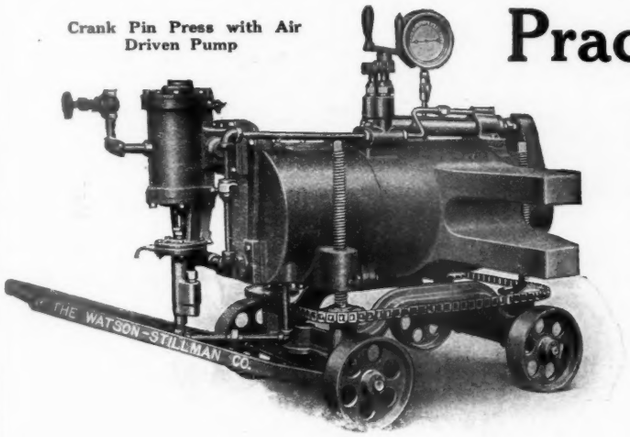
THE FOOTE-BURT CO., Cleveland, Ohio

David Whitney Bldg., Detroit **Wells Bldg., Milwaukee**

HYDRAULIC MACHINERY

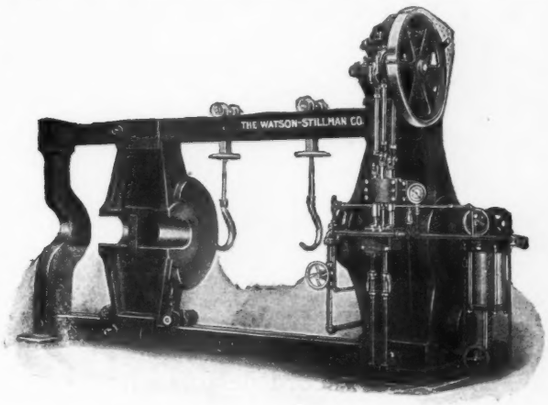
Labor Saving—Powerful—Efficient For Modern Railroad Shop Practice

Crank Pin Press with Air Driven Pump

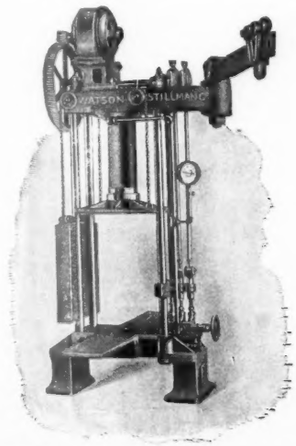


This is the last word in crank pin presses. The old fashioned hand pump is here replaced by an air engine pump. This not only reduces the number of men required to operate it, but increases the speed. These presses are built in capacities up to 300 tons.

We build wheel presses in all sizes and capacities required in present day practice, hand operated, belt or motor driven. The press shown here is our patented hydro-pneumatic type in which the ram movements are effected by combined air and hydraulic pressure. They have three plunger pumps in which one or more plungers may be thrown out of action as pressure demands.



600 Ton Hydro-Pneumatic Wheel Press



100 Ton Hydraulic Locomotive Box and Forcing Press

Our line of forcing presses is built to meet all railroad requirements. The illustration shows a 100 ton press designed to force fit driving box brasses. It is built in several sizes to suit the smallest engine or the largest mallet. The press is self-contained and practically fool-proof. Most railroad shops have one or more in service.

Other machines of our manufacture are benders, bull-dozers, jacks, pit jacks, shaft straighteners, rail benders, punches, shears, wheel presses, forcing presses, forging presses, crank pin presses, pumps, accumulators, valves, etc.

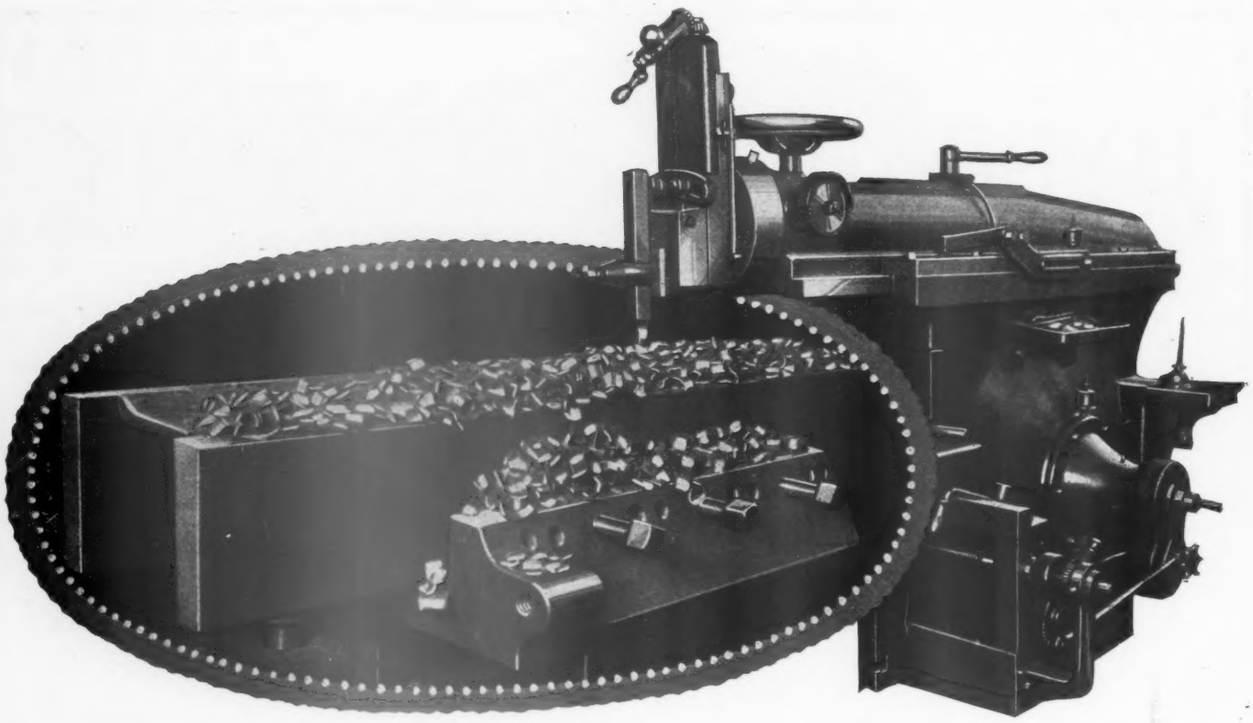
Write for catalogs

The Watson-Stillman Co.

186 Fulton Street, New York

CHICAGO, McCormick Bldg. **PITTSBURGH, Brown & Zortman**

399



Trailer Shoes in 23 Minutes

These shoes are 30½ inches long and 6 inches wide. Three operations were required to complete the work—

1. Roughing cut Cut ⅜"—Feed 1/32". 12 cutting strokes per min.	18 min. 25 sec.
2. Finishing cut Cut 1/64"—Feed ½".	1 min. 30 sec.
3. Rounding edges	3 min. 5 sec.
Total	23 min. 0 sec.

Not a record performance, but a comfortable pace that can be maintained day in and day out on a

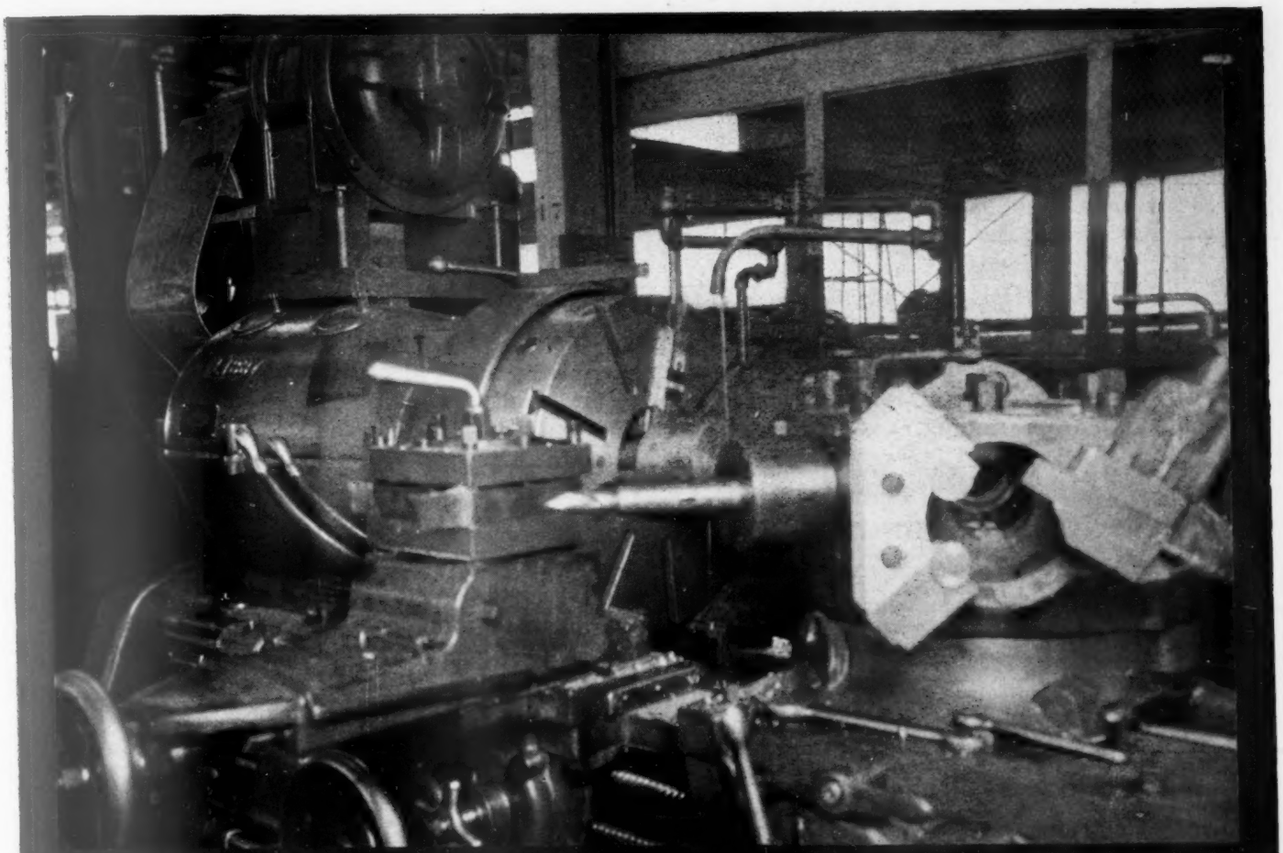
32" "Cincinnati" B. G. Shaper

For both High Speed Production and Accuracy on all work within its range we believe the machine is without a peer. Its gear ratios and pulley sizes make it the most powerful shaper of its stroke on the market. Every part is designed in proportion to the power of the machine, giving it the strength to rigidly withstand any stresses. No effort has been spared to insure as nearly a perfect tool as the machinist's art can produce.

WRITE FOR COMPLETE CATALOGUE

THE CINCINNATI SHAPER COMPANY, CINCINNATI OHIO

The New "Libby"



Turning Scrap Axles Into Knuckle Pins in 29 Minutes

This knuckle pin job in a large railroad shop shows how the New "Libby" "eats up" the work;

Scrap axles have been previously turned to size.
Operations—Cutting to size, facing and threaded in cut-off

R. p. m.	41	Finish cut	¾
Rough cut	1¼"	Feed	1/64"

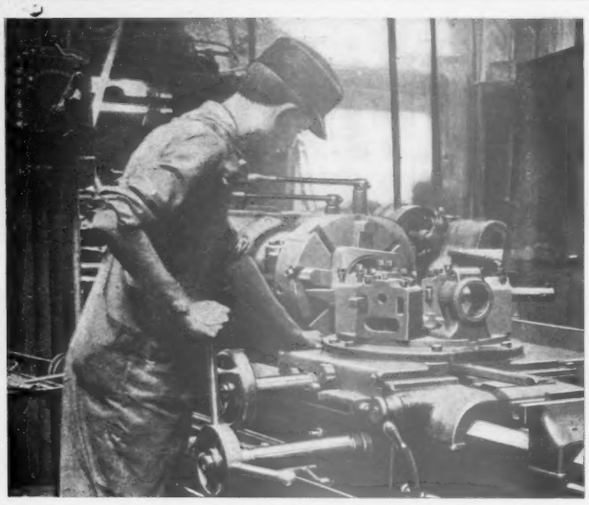
Driver fit to pin.....4¾" long x 6" in diameter
Knuckle fit .....3¾" long x 3" in diameter

Knuckle pins are for a 2—10—2 type engine.

The New "Libby" Type "C" Heavy Duty Turret Lathe can handle every lathe job that comes to a railroad shop. If you are familiar with the Type "B" "Libby" Lathe, you will understand the great working capacity of the New "Libby" when we guarantee an increased saving of from 15 to 25% over former production on the old style machine.

Write for the Railroad Booklet, then consult our Engineering Department for a definite statement on your own proposition.

INTERNATIONAL MACHINE TOOL COMPANY INDIANAPOLIS INDIANA



A 3½" Piston Rod Gland in 30 Min.

The piece requires two chuckings, yet twenty-eight and thirty minutes is the average time for finishing each gland. The operator with a 3¼ x 36"

Cincinnati Acme Flat Turret Lathe

has no difficulty keeping up the same hustling pace hour after hour throughout the day. When one job is finished the change to another is only a matter of minutes as a rule, and when chucking work is finished, the Cincinnati Acme can be inverted for bar work in short order. There are many features in this handy machine that you should know about. Ask us about them.

ACME MACHINE TOOL COMPANY **CINCINNATI, OHIO**

PLANING
Locomotive Guides
on a
Cincinnati Planer

The Cincinnati Planer is peculiarly adapted to Railroad Shop conditions.

It has abundant power and rigidity in every one of its parts.

Variable speeds are an essential feature.

Our belted machines have a patented Tu Speed countershaft, giving two cutting speeds and constant reverse.

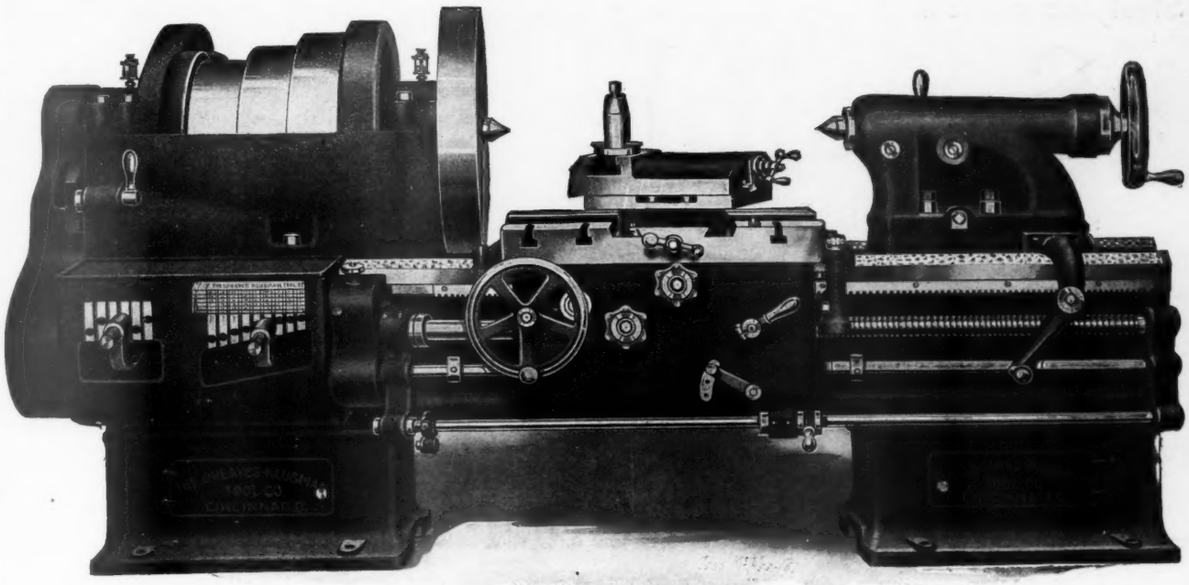
Any type of motor drive can be supplied.

A Cincinnati is an economical producer for the Railroad Shop.

Let us describe these to you in detail.

Cincinnati Planer Co.

CINCINNATI, OHIO



The G. K.—A Heavy Duty Lathe That Looks the Part

Take a long, critical look at this sturdy tool. Doesn't it look as though it could do a real day's work? Hasn't it the appearance of a lathe on which you can depend when work piles up fast and most orders are marked "rush"?

The merits of the Greaves-Klusman Heavy Duty Engine Lathe are almost self-evident to a mechanic—the picture tells him more than words. The massive bowl-type head, the strong, well-ribbed bed, the rugged tailstock and heavy carriage, all bespeak the rigidity and stamina of this sturdy tool. Through the large, wide faced cone pulley ample power for extreme requirements is delivered. The improved quick change gear mechanisms give a wide range of well selected speeds and feeds.

In spite of its power and massive design, the G-K is an easy lathe to operate. Well balanced parts, and the simple, handily located controls, make the operator's job an easy one. Power, strength and handiness make the G-K a popular producer in railroad shops—a favorite alike with the men and shop officials. Ask for our booklet, "G-K Betterments"—it explains in detail.

GREAVES-KLUSMAN TOOL CO.
CINCINNATI OHIO

Steel for Service

Sensible Gears

In these times of high operating costs reason requires that those articles be purchased for specified uses which will give the longest possible service with minimum attention beyond that reasonable care which all mechanism should have to insure most perfect and continuous operation. It is possible by careful selection for the user of power transmitted by gearing, even in these present times, to reduce the cost of maintenance to an absolute minimum.

The best gears are heat treated. The effect of careful heat treatment is to refine the structure and to give it that great strength and toughness which, owing to fine grain of the metal, increases its resistance to wear.

To secure the best results the material on which the heat treatment is performed should itself be of the best.

Carnegie Rolled Steel Gear Blanks

are made of selected steel discs manufactured with the care and skill for which the Carnegie Steel Company is justly noted. The best gears, therefore, are made from Carnegie Rolled Steel Blanks, and to insure the utmost economy in expenditure it is wise for users of large size gears to specify that they be cut from these blanks.

Carnegie Steel Company

General Offices, Pittsburgh, Pa.

936

80% OF DRILL BREAKAGE

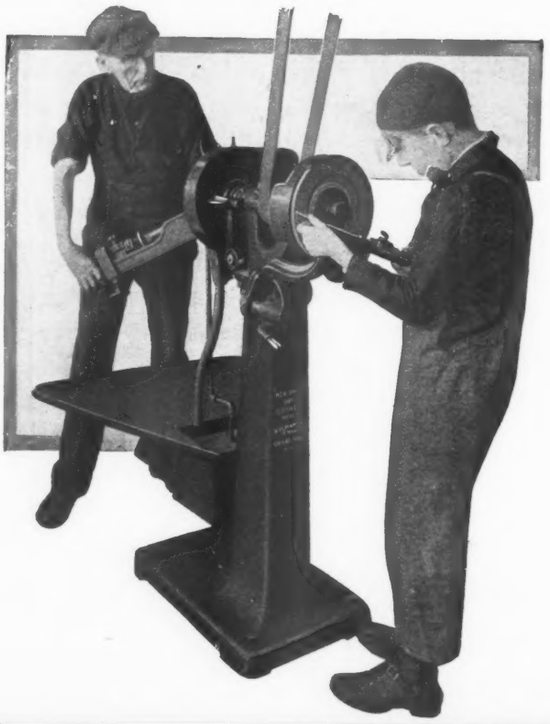
and 50% of wear is caused by imperfect grinding. What is your grinding doing for you.

THE NEW YANKEE DRILL GRINDER

Will pay for itself in a few months, sometimes less.

It automatically grinds both lips the same length, at the same angle and clearance.

Machine shown in cut has capacity from No. 52 to 2¼". The small drills up to ½" are ground dry on a special fine grained wheel. Larger drills are ground wet on the other side and on a coarser wheel.



Catalog on request

WILMARTH & MORMAN CO.

1171 Monroe Ave. N. W.

GRAND RAPIDS, MICH., U. S. A.

AJAX

TRADE MARK REG.

FORGING MACHINERY

And The Electrical Industry

AT the very fore front of all American progress stands the electrical industry and in this industry, a few names are dominant.

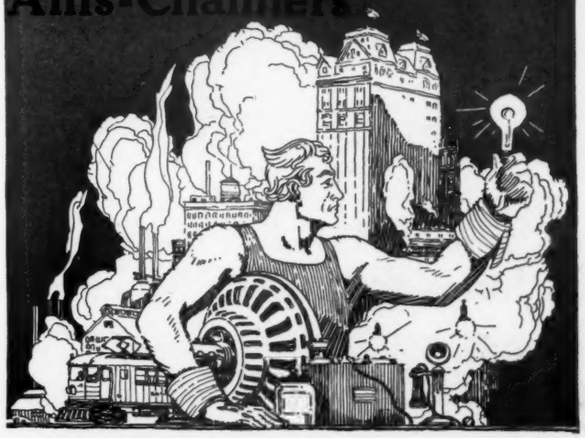
It has been the privilege of the Ajax organization to work with these and other great electrical manufacturers.

Ajax Forging Machinery is making many of the parts that enter into these famous products, making them better, faster and at lower cost than would be possible by other methods.

W WESTINGHOUSE ELECTRIC

GE

Allis-Chalmers



THE AJAX MFG. CO.

Cleveland, O.

621 Marquette Bldg., Chicago, Ill.

1369 Hudson Terminal, New York City

BARDONS & OLIVER

Direct Connected Motor Driven Brass Lathe

If you expect to keep up with the pressure of work in these busy days, you can't afford to be without this versatile tool. For long runs or short, it is equally profitable and the loss of time in changing from one job to another is negligible—an important feature in handling many short jobs. Some of the other features include: Eight Spindle Speeds and Reverse. Speed changes and reverse obtained by friction clutches while machine is running.

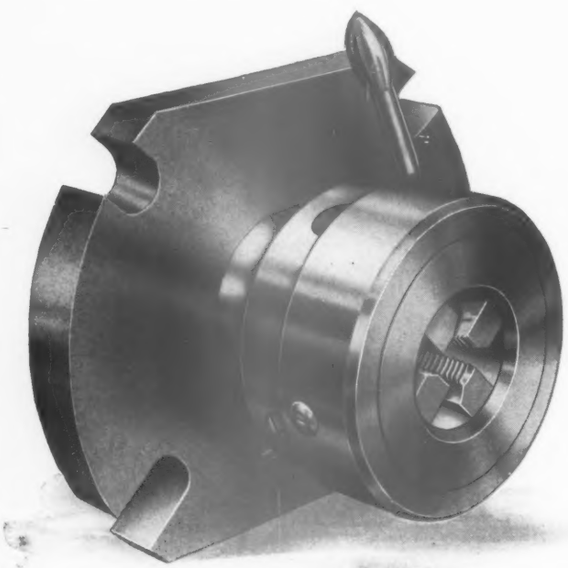
Constant Speed Motor—A. C. or D. C.—direct connected—machine can be placed anywhere in shop.
Chasing Attachment taper guide adjustable along T slot on front of bed—internal or external, Right or Left hand threads cut with same leader and follower.

Single Pulley Drive where electric current is not available entirely eliminating countershafts.

Made in several sizes with different types of turret slide and saddle and with various attachments.

Let us send complete details.

BARDONS & OLIVER **CLEVELAND, OHIO**



THIS shows one of the many Hartness Automatic Dies with special shanks for which we are constantly receiving orders; it is our No. 4 Die ready to bolt to the face of a No. 3—A Warner & Swasey Hollow Hexagon Turret Lathe.

Only 4¾″ Dia., and extending only 4 9/16″ from face of turret, its range is ¼″ to 1¼″ Dia., and 5 to 32 pitch, for threads of any length within the capacity of the lathe.

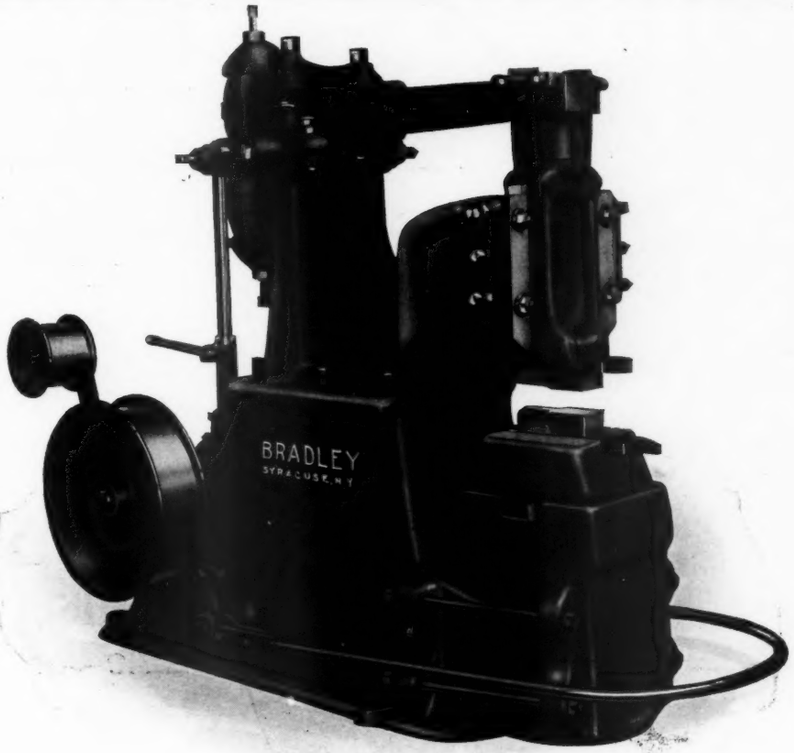
Jones & Lamson Machine Co. Automatic Die Dept. 109 QUEEN VICTORIA ST., LONDON, ENG. SPRINGFIELD, VERMONT, U. S. A.

AMERICAN AGENTS FOR DIES AND CHASERS.

Barwood-Richards Mchy. Co., Bourse Bldg., Philadelphia.
Boyer-Campbell Co., Detroit.
Carey Mchy. & Supply Co., Baltimore.
E. L. Essley Mchy. Co., Chicago, Milwaukee and Moline.
The E. A. Kinsey Co., Cincinnati and Indianapolis.
Machinists Supply Co., Pittsburgh.
Pacific Tool and Supply Co., San Francisco and Los Angeles.
The W. M. Pattison Supply Co., Cleveland.
Robinson, Cary & Sands Co., Duluth and St. Paul.

FOREIGN AGENTS:

For France, Spain and Belgium: F. Auberty & Co., 91 Rue de Maubeuge, Paris.
For Holland: Spliethoff, Beeuwkes & Co., Rotterdam.
For Australia: McPherson's Pty., Melbourne.



The Bradley Upright Helve Hammer

An Indispensable Time Saver

If the Bradley Hammer were used on nothing but the host of odd jobs that come up in the course of a day's work, it would pay handsome dividends. And there are so many jobs in a railroad shop that must be done in a hurry, that a Bradley is simply indispensable in meeting demands. With this snappy, hard hitting tool at hand, the blacksmiths can save many minutes and many an additional heat.

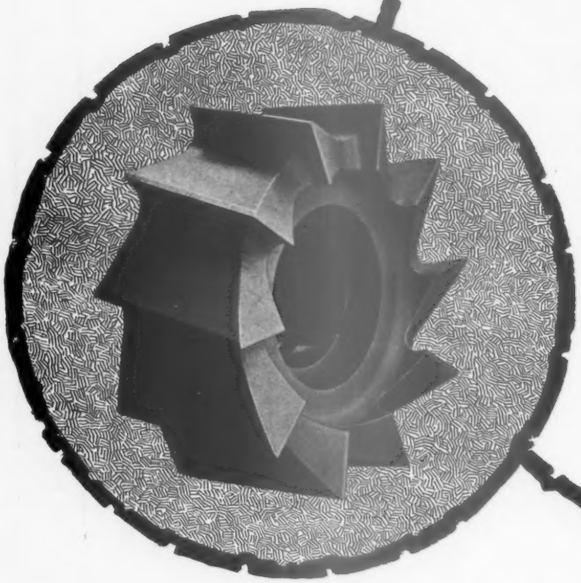
Of course, on work that comes in quantities, the Bradley is a sure winner as a producer. Perfect control and easy operation enables the blacksmith to swing along through a lot of duplicate parts and finish them in record time.

Bradley Hammers are saving time in hundreds of railroad shops. Are they doing it for you? If not, ask us for details.

C. C. BRADLEY & SON, Inc.

SYRACUSE **NEW YORK**

Becker
Milling Cutters



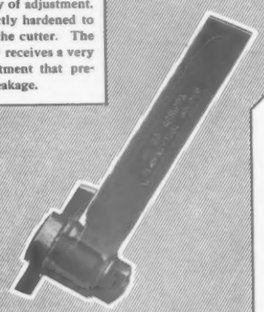
WHEN you send through a requisition for cutters, don't write "Cutters" and let it go at that. Write "Becker" Cutters and see that you get them, too. The difference in the results, the increased production, the better wearing qualities, will amply repay your trouble. The "big chief" looks to keep production up and costs down. One way to help is to specify *Becker* Cutters. They have the quality and stamina to stand the pace in a railroad shop—and they cost no more. A trial order will convince you. Ask for our catalog.

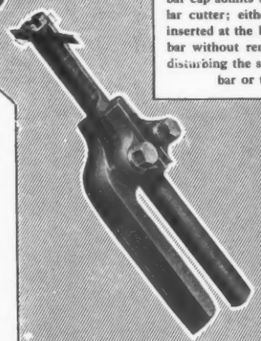
Becker Milling Machine Co.

Hyde Park, Mass.

"Agrippa" Planing Tool has a serrated ring of improved steel which affords unequalled variety and rapidity of adjustment. The ring is correctly hardened to resist the wear of the cutter. The body of the holder receives a very different heat treatment that prevents breakage.

"Agrippa" Boring Tool takes any size or shape of bar and requires no bushings. Its sleeve bar cap admits a straight or angular cutter; either can be quickly inserted at the business end of the bar without removing the cap or disturbing the setting of either the bar or the holder.





Modernize

YOU wouldn't use the best automobile model produced in the 19th century if you got it for nothing. You wisely prefer the cheaper maintenance, improved performance and increased convenience of more modern cars.

You can effect these same identical economies through

Williams' "AGRIPPA" Tool Holders

"THE HOLDERS THAT HOLD

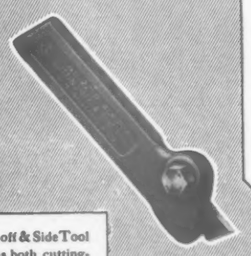
Twentieth Century Improvements

Remember too, while improved roads have made automobile performance easier, tougher steel, heavier machines and higher speeds have rendered tool holder accomplishment more difficult.

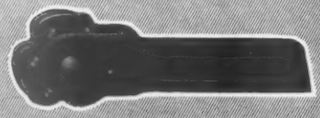
You Need Every Modern Tool Holder Advantage **Now**

We will ship them promptly if your dealer can't supply you from stock.

J. H. WILLIAMS & CO.
86 Richards Street, Brooklyn, N. Y. City



"Agrippa" Cutting-off & Side Tool A tool that performs both cutting-off and side work by the mere substitution of suitable cutters tells its own story of economy.

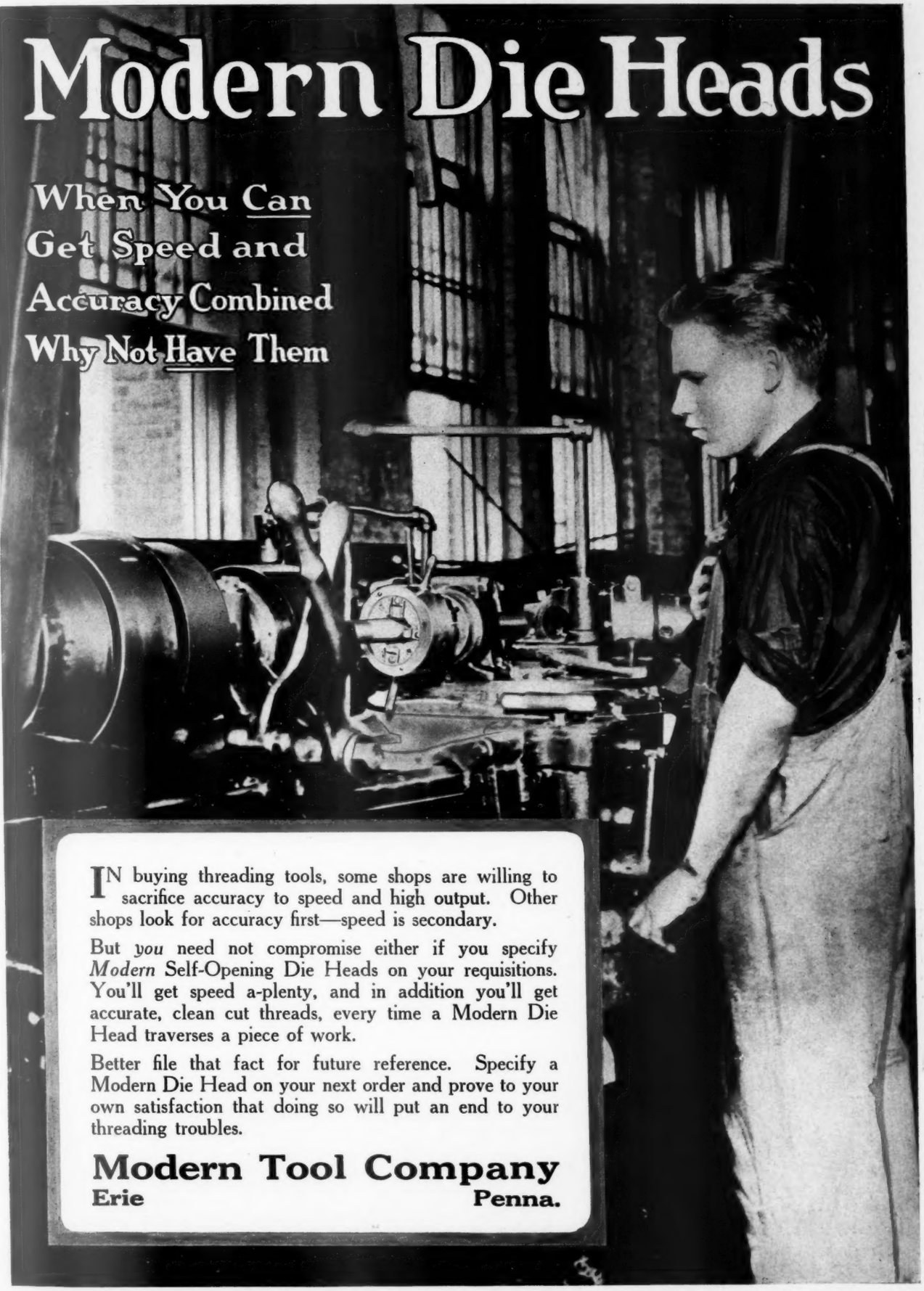


"Agrippa" Threading Tool with lockable spring head, will do roughing, finishing and threading at one setting in one tool post.

J. H. WILLIAMS & CO. THE WRENCH PEOPLE

Modern Die Heads

When You Can Get Speed and Accuracy Combined Why Not Have Them



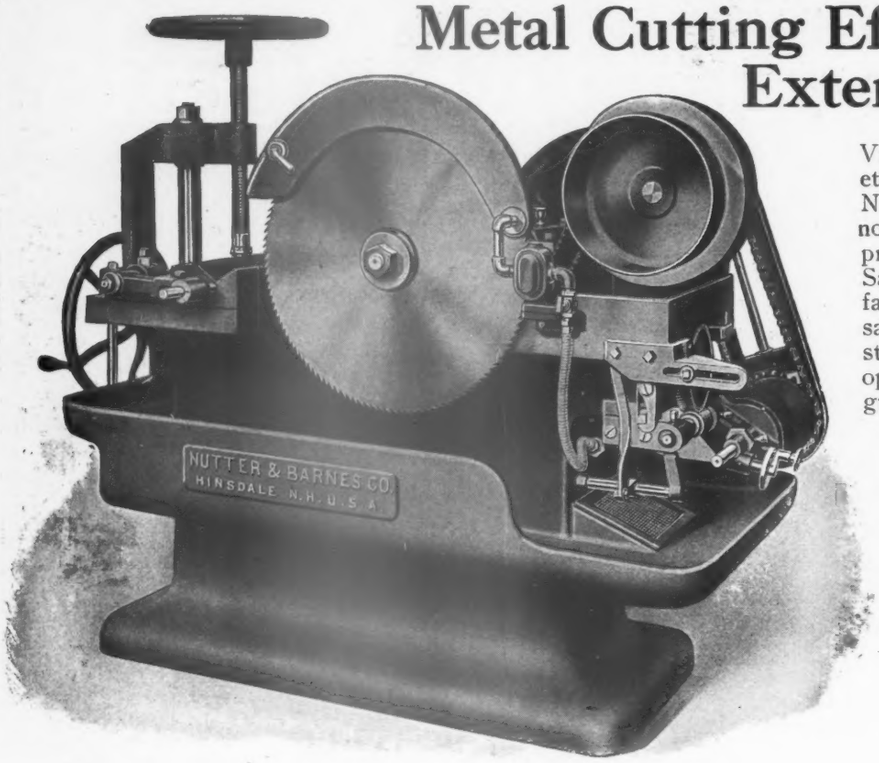
IN buying threading tools, some shops are willing to sacrifice accuracy to speed and high output. Other shops look for accuracy first—speed is secondary.

But *you* need not compromise either if you specify *Modern* Self-Opening Die Heads on your requisitions. You'll get speed a-plenty, and in addition you'll get accurate, clean cut threads, every time a Modern Die Head traverses a piece of work.

Better file that fact for future reference. Specify a Modern Die Head on your next order and prove to your own satisfaction that doing so will put an end to your threading troubles.

Modern Tool Company
Erie **Penna.**

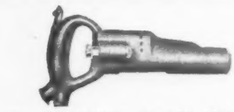
Metal Cutting Efficiency that Extends to Safety

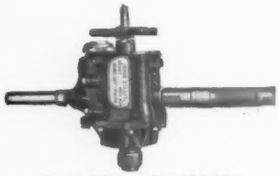


Vital as speed, flexibility, power, etc., are, their development in N & B Cutting-Off Machines is not the whole reason why the most progressive shops use N & B's. Safety is also a well developed factor in N & B machines. The saw itself is covered with a substantial hood, and all gearing and operating parts are effectively guarded.

How *safely* N & B Cutting-Off Machines operate is included with the performance facts of output, accuracy and low costs that we will send you if you will simply ask for catalog.

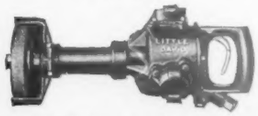
NUTTER & BARNES CO.
Hinsdale, N. H.
13 So. Clinton St. Chicago


No. 3S "Little David" Chipping Hammer


No. 2 "Little David" Non-Reversible Drill

No. 90 "Little David" Long Stroke Riveting Hammer with Safety Retainer

No. 33SC "Little David" Reversible Drill


No. 7 "Little David" Grinder

SPEED UP!

Don't waste time working by hand and don't waste it moving heavy work—"Little David" Pneumatic Tools are waiting to do your portable drilling, reaming, tapping, grinding, chipping, riveting, etc., at a fraction of the cost of hand work.

There's a tool for every duty and a size particularly suited to each grade of work.

They are easily operated and as easily understood. They stand up to the work:—upkeep is inexpensive and air consumption low.

Ask for the complete "Little David" Catalog.

INGERSOLL-RAND COMPANY

11 Broadway, New York 165 Q. Victoria St., London

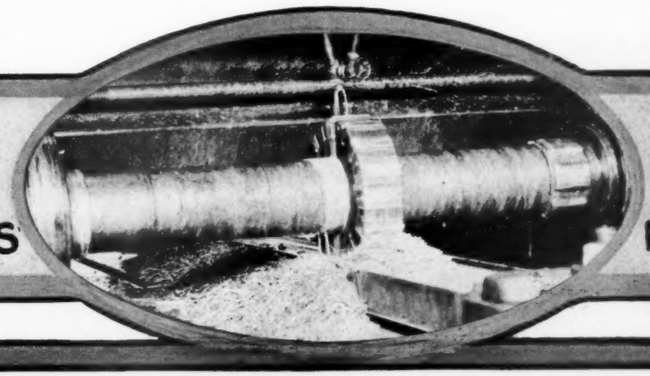
Offices the World Over

59-PT

A Rush Job?—Do It on the Newton

That's the invariable order in a big mid-western shop whenever a heavy milling job is wanted in a hurry. When the foreman makes a promise on a "Newton" job, both the foreman and the Newton "make good." So when an urgent order for a new main rod for a disabled Pacific engine came in, the Newton Miller did the job. "It will be ready at four o'clock," said the foreman. "Are you sure?" he was asked. "I'm positive," was his reply; "I've had that Newton almost five years and I have never known it to 'fall down' on a job yet. Incidentally, the Newton saves time and gives a far neater job than planing." At four o'clock the rod was finished, as far as milling was concerned.

In these critical days a speedy, dependable machine is a real asset. Newton Millers in scores of railroad shops today are showing results that vindicate the judgment and foresight of the discriminating shop officials who specified them. Ask for a Newton catalog.



NEWTON MACHINE TOOL WORKS

23rd & VINE STREETS PHILADELPHIA

BRUBAKER

Special Tempered Relieved Staybolt Taps

BRUBAKER quality is not a matter of chance—it is a scientific certainty, every time. Special machinery insures accurate pitch and careful and correct relief. Improved methods of heat treating mean uniform and serviceable temper. Then thorough inspection practically eliminates the possibility of defective taps getting into stock. That's why Brubaker Taps cut faster and cleaner and will last fully 20% longer than the "average" tap. How about a 30-day trial. Ask us.

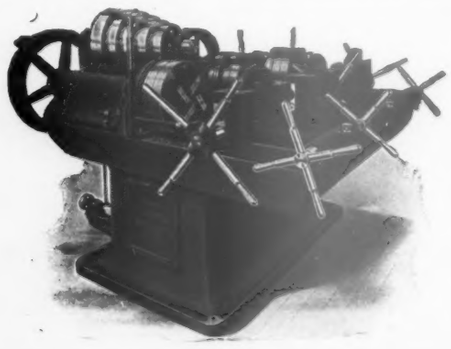
W. L. Brubaker & Brothers
50 Church Street New York, N.Y.

Have you Landis-ized your Threads?

Are you using the Landis Die to cut your threads and thereby obtain a maximum production of high quality threads at a low cost?

If not, get in line with other progressive manufacturers and make your threading profitable. One customer writes: "We have made an increase in production of 30 to 40% and a saving in the cost of chasers of 50 to 60% since installing your machine."

Consider the design of the Landis chaser. It never requires annealing, hobbing or retempering, merely a slight grinding at the end renews it; right and left hand threads are cut with the same set of chasers; it is ground like a lathe tool, permitting any desired clearance without changing the cutting contour, and it has a line contact with the stock, permitting of the highest cutting speeds.



Learn the many other distinctive features. Write for catalogues:

No. 22—Bolt Cutters.
No. 23—Pipe Threading Machines.

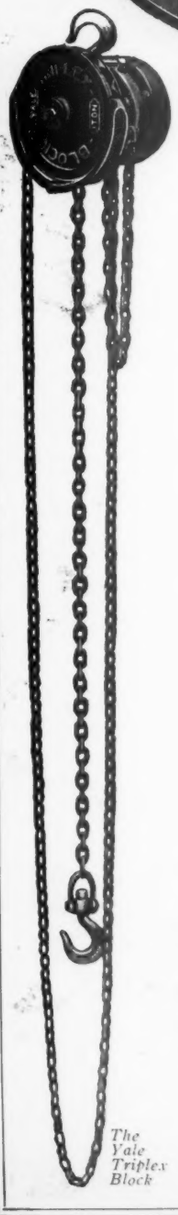
Landis Machine Company, Inc.

Waynesboro, Pa., U. S. A.

MILITARY experts agree that the war will be won by the side using the most aeroplanes—
Machinists and expert mechanics agree that the extreme limit of production from lathe, planer, miller or other machine tool can only be obtained by using—
"Red Cut Superior"
The Nationally Known First Quality
HIGH SPEED STEEL
"IT'S THE BEST FOR ALL MACHINE WORK"
VANADIUM-ALLOYS STEEL CO.
PITTSBURGH, PA. Works at LATROBE, PA.
CARRIED IN STOCK AT THESE WAREHOUSES:
E. T. WARD'S SONS 44 FARNSWORTH ST BOSTON MASS.
GEO. NASH CO. 304 HUDSON ST NEW YORK, N. Y
FIELD & CO. INC. 721 ARCH ST PHILADELPHIA, PA
VANADIUM-ALLOYS STEEL CO. PITTSBURGH PA AND LATROBE, PA
GEO. NASH CO. 645 WASHINGTON BLV'D CHICAGO, ILL.

TRADE YALE MARK

Triplex Block setting steel bars



The Yale Triplex Block

Yale Hoists—

—the friend of Labor

No better method for increasing the productive efficiency of highly paid labor can be found than the use of the Yale Triplex Block to facilitate the rapid, safe and economical handling of loads.

The Yale Triplex Block also increases output by cutting down non-productive time of machines. Rough material is quickly set and finished product safely and expeditiously removed.

The Yale Triplex Block is adaptable to every industry where the efficient handling of loads is a factor. Made in capacities ¼ ton to 40 tons—each block is tested to 3360 pounds for each rated ton.

For Sale by Machinery Supply Houses

Put your hoisting problems up to us.

ASK FOR NEW CATALOG

For factory locking equipment use a Yale Master-key System. Write us for particulars.

The Yale & Towne Mfg. Co.

9 East 40th Street
New York

Speed Up Your Shop Work

How do you handle your driving wheels? Do you still block one wheel to change the direction of movement? You can speed up your shop work by installing

Universal Industrial Turntables

Their use will effect a saving in time; also an efficient means of distributing and picking up work. Remember that their construction is such that they will withstand hard usage.

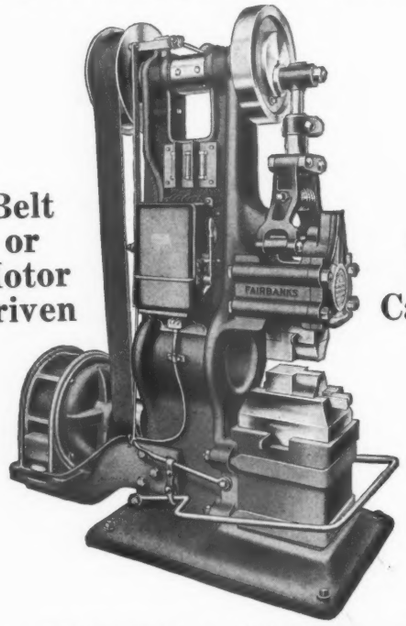
CANTON FOUNDRY & MACHINE CO.
CANTON **OHIO**

Manufacturers of
Industrial Turntables, Portable Floor Cranes and Hoists.

Bulletin F-17 contains interesting data. Let us forward a copy.

FAIRBANKS HAMMERS

Belt or Motor Driven

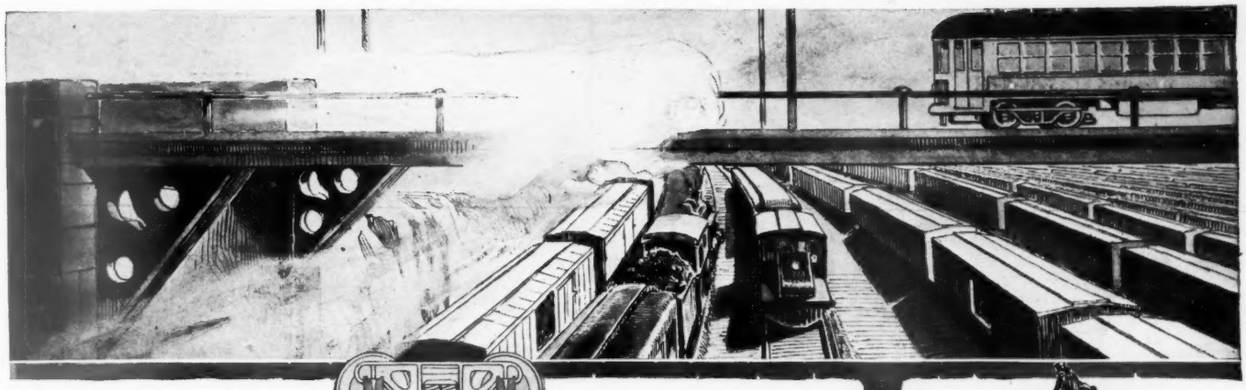


Ask for Catalog

UNITED HAMMER CO.
141 Milk Street **Boston, Mass.**

SALES AGENTS

The Fairbanks Co.—Albany, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Hartford, Newark, New Orleans, New York, Philadelphia, Pittsburgh, Providence, St. Louis, Syracuse, Havana, London, Glasgow, Hamburg, Paris.



The saving in Labor cost *alone* will mean a profit if you use this scientific method of journal lubrication.

1196 votes were cast for a better method of car journal packing by the representative members of the Master Car Builders' Association.

Everybody agrees that the waste and oil method of journal lubrication is extravagant—both because of the high labor cost involved and the unnecessary waste of oil—and the fact that it is not a really efficient method of lubricating a car journal.

Hundreds of steam and electric railways are taking advantage of the new scientific method which protects their service and effects a saving of thousands of dollars yearly, in labor cost alone. *Your* road can save money if it adopts

ASBESTESE

Asbestese is a composite mass of high grade grease mixed with asbestos and pure long fibre wool yarn. It is a product of the Swan & Finch Engineering Department—a result of 64 years of scientific grease production.

Efficiency

The superiority of a scientific grease over oil, for journal lubrication, is obvious. Asbestese maintains its lubricating consistency under all temperatures—from 30° below to 300° above. It lubricates instantly and constantly—bearings cannot become over-heated. Because of its heavy body the grease "stays put"—cannot be absorbed by the waste, then to leak out of the box. Furthermore, the consistency of Asbestese gives greater heat-absorbing power.

Economy

The special wool that is combined in the packing enhances the protective qualities of Asbestese. Four to eight months is a conservative length of service under very severe service for Asbestese. Asbestese has lasted as long as two years, without repacking. Only infrequent inspection is necessary, as a matter of *extreme* precaution.

Asbestese is uniform. If each journal box were packed by a different workman, each would have a lubricant of the same consistency. It is these qualities which make frequent repacking unnecessary. What does this means in augmented efficiency?

In order to conclusively prove the ability of Asbestese to function properly, we would appreciate the privilege of sending you a suitable quantity for a practical test.

Pack a journal with Asbestese and let its contrast with ordinary packing speak for itself. Write now.

A permanent, profitable distributing connection is open for the world-famous S-F Atlas specialty line. Write for particulars.

SWAN AND FINCH COMPANY
NEW YORK

Quality Oil and Grease Products Since 1853

Specialties

SLO-FLO
The super-lubricant—will not drip, climb nor spatter—withstands excessive heat and pressure.

CUPESE
A quality cup grease for all machinery requirements.

ASBESTESE
An asbestos and wool-mixed grease lubricant for car journals.

CORUL
A liquid binder that meets the 11 requirements of perfect core casting.

AERUL
A practical high quality oil for aeroplane motors.

MOTUL
A superior quality motor oil for the protection of valuable automobiles.

GEARESE
A correct transmission and differential lubricant for motor cars and trucks.

TEXTUL
An economical, high quality oil compound for wool and worsted manufacture.

MARINUL
A world-known special oil, produced to meet the excessive stresses of marine service.

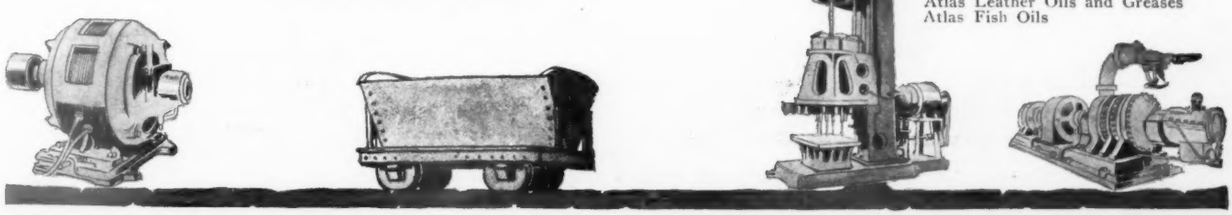
TALESE
An economical, practical drop-forge die-swabbing grease compound.

EXESE
The 600° F. Lubricant—for oven gears—bloom cars, calender rolls, automatic stokers—or lubrication under excessive heat conditions anywhere.

VESUVESE
A waterproof lubricant for exposed gears—for cable dressing.

LARCUL
A practical, economical metal-cutting lubricant.

ATLAS GENERAL LINE
Atlas Engine Oils
Atlas Cylinder Oils
Atlas Turbine Oils
Atlas Dynamo and Motor Oils
Atlas Crank Case Oils
Atlas Transformer Oils
Atlas Cutting Oils
Atlas Tempering and Quenching Oils
Atlas Spindle and Loom Oils
Atlas Wool Oils
Atlas Leather Oils and Greases
Atlas Fish Oils



The Star Which Indicates Service

Time is Valuable Today

AND

Here is a Wrench That Saves It

A WRENCH that wastes time has no place in railway repair work or repair kit. Time counts as well as strength today—a wrench possessing great reserve strength and quick action—that's the wrench for Railway Wartime Service.

Take a "Coes" in your hand. Yes, that is it, the

"COES" RAILWAY WRENCH

A strong wrench! You are right, it is, fully 30% stronger than any other wrench made. Why man, that wrench will last 30% longer than any other wrench, yet it costs you but 5% more, and remember the "Coes" will stand every test—hottest temperatures one minute—coldest the next. Steam and moisture affect not this wrench which

Insures Enduring Service

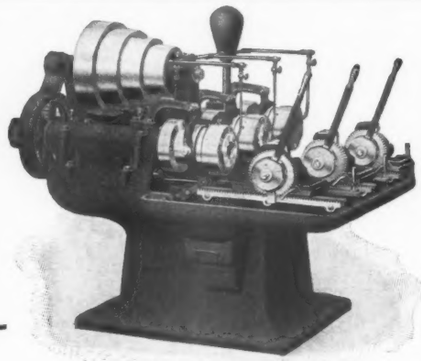
COES WRENCH CO.

Worcester, Mass, U.S.A.

Agents: J. C. McCarty & Co.
29 Murray St., New York.
438 Market St., San Francisco, Cal.
1515 Lorimer St., Denver, Colo.

Agents: John H. Graham & Co.
113 Chambers St., New York.
118-122 Holborn, E. C. London.
Fenwick Freres, Rue de Rocroy, 8, Paris, France

The name which insures wrench service



The National Bolt Cutter

saves you 30 to 50% in Die cost and machine upkeep.

In R. R. shops and Industrials results show that it costs less per bolt when threaded on the NATIONAL.

And users will tell you that the NATIONAL always cuts accurate thread. No tapering thread, no "oversize," no loose fits.

The NATIONAL gives you effective results with unskilled labor.

Built in ¾ to 6 Inch Sizes. Single, Double, Triple and Quadruple Spindle

The National Machinery Company

Tiffin, Ohio, U. S. A.

Ashton Wheel Press Recording Gages

Ashton Wheel Press Recording Gages give an accurate record of wheel fits on axles, showing actual fit from start to finish, insuring perfect mountings.

Send for special circular which gives full details, also catalogue describing our complete line of Specialties.

The Ashton Valve Co.

BOSTON, MASS.
271 Franklin St.

CHICAGO, ILL.
608 So. Dearborn St.

"Credit Where Credit Is Due"

OF all types of hydraulic and pneumatic machinery the very last to abandon the antiquated method of forming the packing leathers by the act of installation was the railway air-brake. Even today there are air-brake manufacturers who are only luke-warm in recommending formed leather packings.

Before VIM Leather Air-Brake Packings were placed on the market, no one featured the advantages of using a formed packing.

As a matter of fact the so-called formed oak leather packings are crude affairs compared with the perfectly moulded VIM Leather Air-Brake Packings, because it is impracticable to properly mould an oak leather air-brake packing.

VIM Leather Air-Brake Packings are so moulded that the same quantity of leather fibre exists in every portion of the packing, while the formed oak packings are so drawn that the fibre is drawn from the shoulder or bend where the greatest strain comes, and consequently the packing is weakest where it should be strongest.

But VIM Leather Air-Brake Packings are best mostly because they are made from VIM Leather, which is acknowledged by all unprejudiced experts to be best for the purpose.

SINCE 1865

E. F. HOUGHTON & CO.

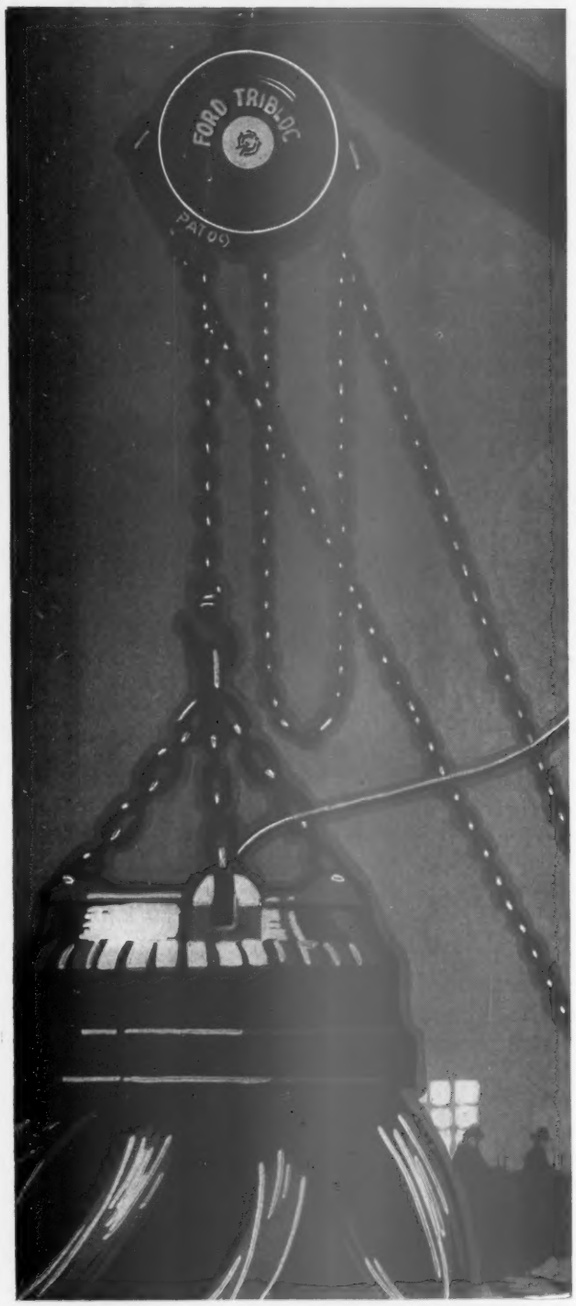
Publishers of The HOUGHTON LINE

THIRD, AMERICAN AND SOMERSET STREETS

PHILADELPHIA

New York	Pittsburgh	Cleveland	Detroit	St. Louis	Syracuse	San Francisco
Boston	Cincinnati	Chicago	Albany	Buffalo	Hartford	Portland, Ore.

FORD TRIBLOC



Widely Used and Imitated Chain Hoist

Naturally a hoist that enjoys the popularity and possesses such merits as the anti-gag LOOP Hand Chain GUIDE, planetary spur gearing and steel working parts, as does the Ford Tribloc, blazes a trail that others try to follow.

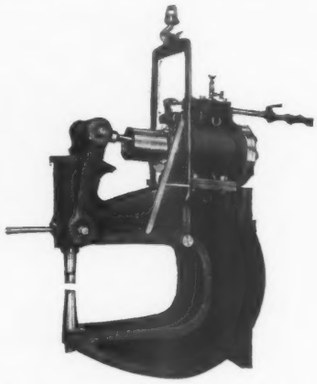
For mutual protection know that the LOOP Hand Chain GUIDE is a patented feature that no manufacturer has the right to embody in a Chain Hoist without license from us.

Get Catalog 3 for full particulars.

FORD CHAIN BLOCK & MFG. CO.,

145 Oxford Street **Philadelphia, Pa.**

2106-D



Allen Riveters

are designed to give top-efficiency service—the fastest, tightest riveting, at lowest cost—and may be depended upon to make good.

For 45 years they have set an exceptionally high standard for mechanical excellence, and still lead.

Send for Catalog with full facts

JOHN F. ALLEN COMPANY

Pioneer Builders of Riveting Machines.
372 Gerard Avenue, New York

NO EQUIPMENT IS SO EXPENSIVE AS IDLE EQUIPMENT

The tools that will put repair jobs back on the track in the shortest time are the ones to use.

YOU NEED

"MORSE" TOOLS

DRILLS, REAMERS, TAPS, CUTTERS

Catalog on request

Morse Twist Drill & Machine Co.
New Bedford **Mass.**

BED CASTING PATTERN FOR ROTARY SNOW PLOW

Three men—a pattern maker and two helpers—were able to make the complete pattern and core boxes required for the bed casting of a rotary snow plow. Total time was less than ten days. The only waste in lumber was a bag of saw dust.

Pattern making in modern railroad shops equipped with Gardner Patternmaker's Disc Grinders shows a saving of from 25% to 50% over the old methods formerly employed.

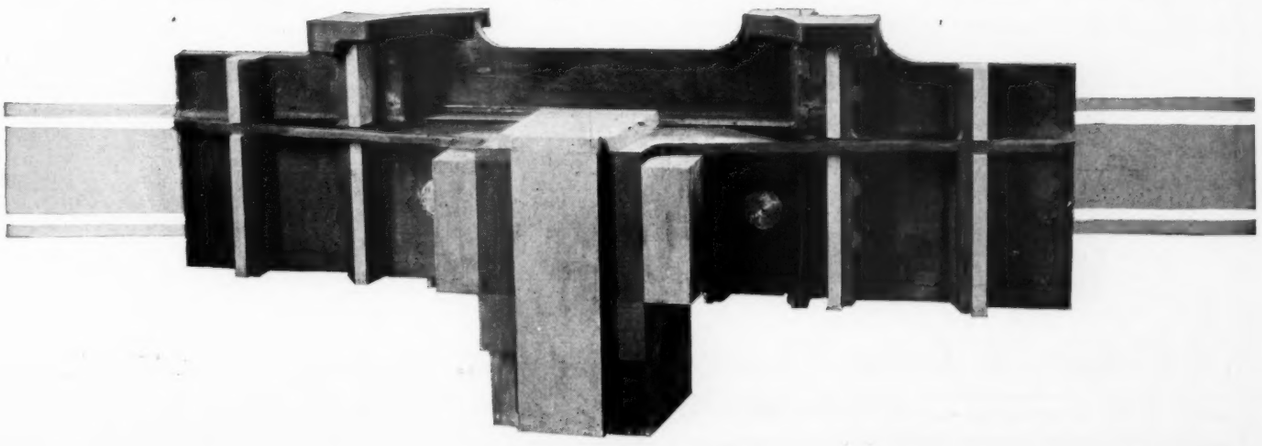
Any boy of average intelligence can equal the work of a skilled patternmaker and thus increase the output of your pattern shop without increasing the labor cost. The many uses of a Gardner Disc Grinder make it possible to save the cost of the machine in less than three months' time.

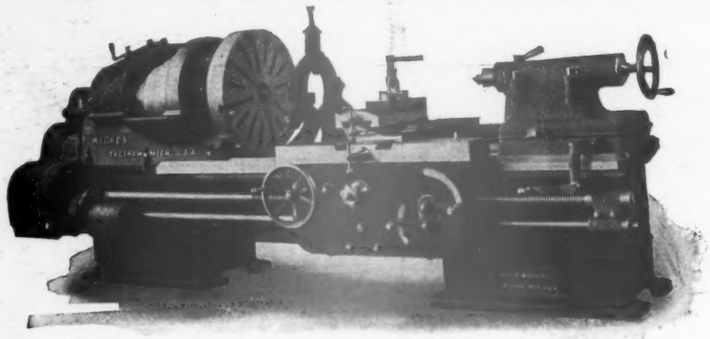
The saving in lumber—quantity and quality—is another important feature to railroads.

If you prefer, we'll make your patterns in our shops and show you how much can be saved by equipping your own shops.

Our Railroad Department is at your service to solve your problems. Write, wire or 'phone for details.

GARDNER MACHINE COMPANY **Beloit, Wisconsin**





32" Wickes Heavy Duty Engine Lathe

WICKES

Heavy Duty Engine Lathe, Built any lengths, has 3 step cone, is double back geared and has double plate apron. Built belt or motor driven.

Let us tell you about this and also our 26" and 18" lathes.

Wickes Bros.
SAGINAW - MICH.

DROP FORGING SPECIALISTS

STEEL CAR FORGE CO.
Pittsburgh, Pa.

Increase Your Man Power

Don't let the shortage of labor curtail your boiler output. Today it is a patriotic duty to keep locomotive boilers in good shape and to reduce time on every repair job that comes into your shops.

FAESSLER TOOLS

Will Help You Do It

The Faessler Safety Sectional Expander leads the Faessler line as a man-power booster. It dispenses with the need of a helper. It lets one man do twice as much work as two men with ordinary tools.

Other Faessler Tools are built on the same principle—to save men and increase output.

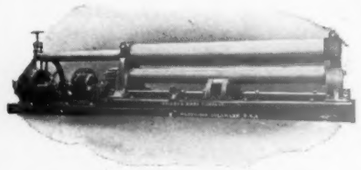
Patriotism and hard headed common sense should make you investigate these Tools—a post card will bring you our catalogue.

J. Faessler Mfg. Co.
MOBERLY, MO.

BOSS

St. Louis—Railway Exchange Building

82



Pyramid type made in twelve sizes.

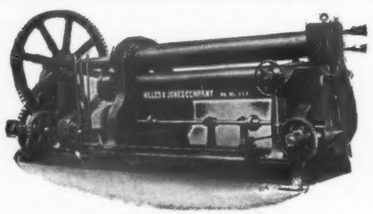
Cut shows heavy capacity Rolls equipped with separate motors for driving and operating the top roll.

Plate Bending Rolls

Capacity and length to suit requirements

Punches, Shears, Straightening Rolls, Rotary Bevel Shears, Flanging Clamps, Plate Planers, etc.

Established 1854



Pinching type made in seven sizes.

Plate is bent nearer the edge, doing away with most of the objectionable flat on edges of plates rolled on the usual pyramid type.

Hilles & Jones Company, Wilmington, Delaware
Pittsburgh Office, 235 Oliver Building

We are not Playing Checkers

Every man-jack of us at the Carborundum plant is working like the proverbial beaver, for never before has there been such a demand for Carborundum and Aloxite Products.
We are doing our level best to meet this big demand—enlarging our plants, increasing our forces, speeding up production—we are even building a big 20,000 horse power furnace plant in Canada in our efforts to keep up with things. We have a definite service to perform for we are helping to produce the necessities of war.

Carborundum and Aloxite Products are Doing Their Bit

They are grinding shrapnel shells, high-explosive shells, rifle barrels and parts—grinding bayonets and sabers. They are grinding a hundred and one different parts of the aeroplane and the auto truck, the machine gun and the field gun. They are shaping armor plate and grinding car wheels; grinding plowshares, and the tools of the metal-working trades of the world. They are grinding torpedo tubes and torpedoes, grinding submarine engine bases; beveling the lenses of periscopes and buffing the soles of the army shoes and grinding the shears for the pocket kits of the "Sammies." They are doing a thousand and one war tasks quicker and better than they have ever been done before.

Carborundum and Aloxite products are surely doing their bit, but with it all we haven't neglected for one instant our regular patrons—we are doing all in our power to keep up with the pace; to keep up to the standards of Carborundum service.

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.

NEW YORK CHICAGO BOSTON PHILADELPHIA CLEVELAND CINCINNATI
MILWAUKEE PITTSBURGH GRAND RAPIDS

Machine Tools Railroad Shop Equipment

OUR line of equipment for the railroad repair shop is complete and includes steam hammers, forging machines, axle lathes, car wheel borers, slotters, shapers, drilling machines, grinding machines, lathes, etc.

Our service makes it profitable to buy from us. Send us your inquiries.

SHERRITT & STOER COMPANY
INCORPORATED

Finance Building **Philadelphia, Pa.**

DUFF

Easiest Operating Car Box Jack Ever Designed—!

The hitherto impossible ease of operation which has been obtained in the Duff Improved Ball Bearing Journal Jack means something more than mere comfort to the user. The significance of the quick and easy response obtained under heavy loads, as well as under lighter ones, is that friction is an absent factor.

DUFF JOURNAL JACKS

The importance of this lack of friction cannot be over estimated, for where there is no friction, there can be no wear to speak of, and without wear upkeep becomes a question unnecessary to be considered. Only injury to the working parts through misuse will cause the Duff Improved Journal Jack to be sent to the repair shop. Lack of space makes it impossible to explain the construction of this Jack, but a Special Bulletin tells the story in full. Ask for it today.

The DUFF MANUFACTURING CO., Established 1883, Pittsburgh, Pa.
New York Chicago Atlanta St. Paul San Francisco

Kelly PRODUCTION Tools

for Cylinders, Crank Cases, Connecting Rods, Auto Parts, Etc.

TRANSMISSION CASE TOOLS (13 OPERATIONS) FOR MOLINE PLOW COMPANY
J. M. DAVIE, GENERAL SUPERINTENDENT THE KELLY REAMER CO.

We Make **DELIVERIES** in 1 to 10 Days

They **"ADJUST"** Write for the Catalog G-R

THE KELLY REAMER CO.
CLEVELAND, OHIO, U. S. A.

C. W. Burton, Griffiths & Co., London, English Agents.
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Jessop's Best Carbon Steel and "Ark" High Speed Steel

FOR DIES AND HIGH GRADE TOOLS

Always Uniform

ARK.

Most Economical

Jessop's "Ark" High Speed Steel

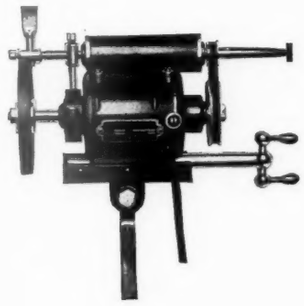
Has Stood the test. Has many imitators but no equal
Manufactured in Sheffield, England

TOOL STEEL FORGINGS

Wm. Jessop & Sons, Inc., 91 John Street, New York City

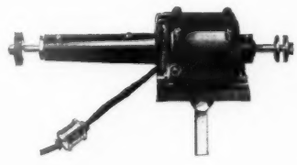
Boston Warehouse, 163 High Street **St. Louis Warehouse, 714 No. 2nd Street** ***Warehouses throughout the U. S.***

Equipment For Standard Dumore Grinder



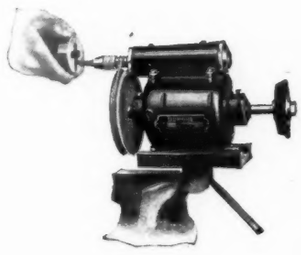
Equipment "A"

General Tool Room use. Includes high speed internal spindle—Reach 3 inches—speed, 30,000 R. P. M. Motor spindle speed 10,000 R. P. M.



Equipment "B"

Deep Internal Work, 10 inch extension arm. Speed, 10,000 R. P. M.

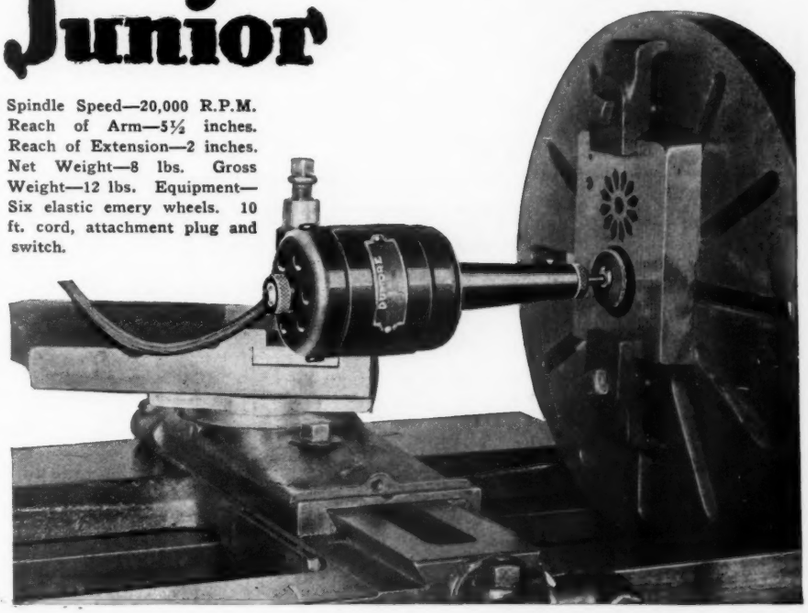


Equipment "C"

Button Die Grinder. Speed, 50,000 R. P. M.

Another Dumore Grinder — The Dumore Junior

Spindle Speed—20,000 R.P.M. Reach of Arm—5¼ inches. Reach of Extension—2 inches. Net Weight—8 lbs. Gross Weight—12 lbs. Equipment—Six elastic emery wheels. 10 ft. cord, attachment plug and switch.



The Dumore Junior Grinder has been designed to meet the requirements of the manufacturer who desires a light grinder which will do accurate work, yet who does not wish to invest in a larger and more expensive tool. Invaluable for the accurate grinding of tools, dies and gages—can be quickly attached to lathes or other machine shop equipments. The

DUMORE JUNIOR PORTABLE ELECTRIC GRINDER

is built in the same conscientious manner and embodies the same special features as the larger Dumore Grinders. The armature is dynamically balanced and the spindle operates at 20,000 R. P. M. Friction is reduced to minimum by using high grade Ball Bearings. This scientific construction has entirely eliminated vibration, and any work ground with the Dumore Junior will be found accurate and free from chatter marks.

Like all other Dumore products, this new grinder is sold on its merits. Write today for descriptive literature.

Wisconsin Electric Company

4010 Dumore Bldg. **Racine, Wis.**

Sold in England by Canadian American Machinery Co., Ltd., 8 Bouverie St., London, E. C., England.

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Counselor in Patent Causes

Solicitor of American and Foreign Patents

Norris Office Building, Erected 1880

James L. Norris

Member of the American Patent Law Association

ESTABLISHED 1869

Cor. F & 5th Sts., N. W., Washington, D. C.

SEARCHES MADE and opinions given as to the validity and infringement of Letters Patent.

Information as to cost and procedure free on request

ERIE STEAM HAMMERS

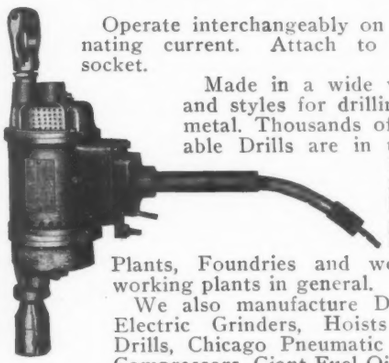
Can be found in practically every up-to-date Railroad Shop, "Doing Their Bit" and some more.

We build other types of hammers also. May we send you Bulletins?

ERIE FOUNDRY COMPANY

ERIE PENNA.

Duntley Portable Electric Tools



Operate interchangeably on direct or alternating current. Attach to ordinary lamp socket.

Made in a wide variety of sizes and styles for drilling in wood and metal. Thousands of Duntley Portable Drills are in use in Machine Plants, Boiler Shops, Automobile Plants, Repair Shops and Garages, Steel Plants, Foundries and wood and metal working plants in general.

We also manufacture Duntley Portable Electric Grinders, Hoists and Hammer Drills, Chicago Pneumatic Simplate Valve Compressors, Giant Fuel Oil Engines, Little Giant Air Drills, Boyer Pneumatic Hammers, and electric and pneumatic appliances of every description.

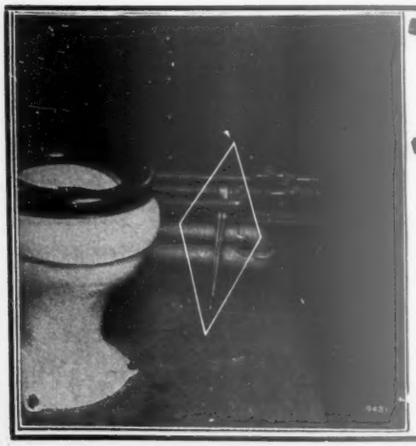
Send for Bulletins.

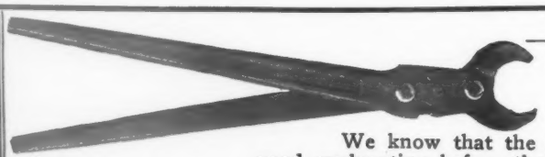
Chicago Pneumatic Tool Company

1066 Fisher Bldg. Chicago — 52 Vanderbilt Ave. New York

BRANCHES EVERYWHERE

K-3





We know that the LaRock Wrench needs a good explanation before the distinct points of usefulness of the LaRock on close clearance work will be apparent.

We know that the merits of the LaRock Wrench cannot be seen at once.

If the advantages of the LaRock Wrench were explained to you it is certain that the wrench would be given a thorough test on all air-brake pipe, water pipe, steam pipe, and electrical conduit pipe work on passenger cars and engines.

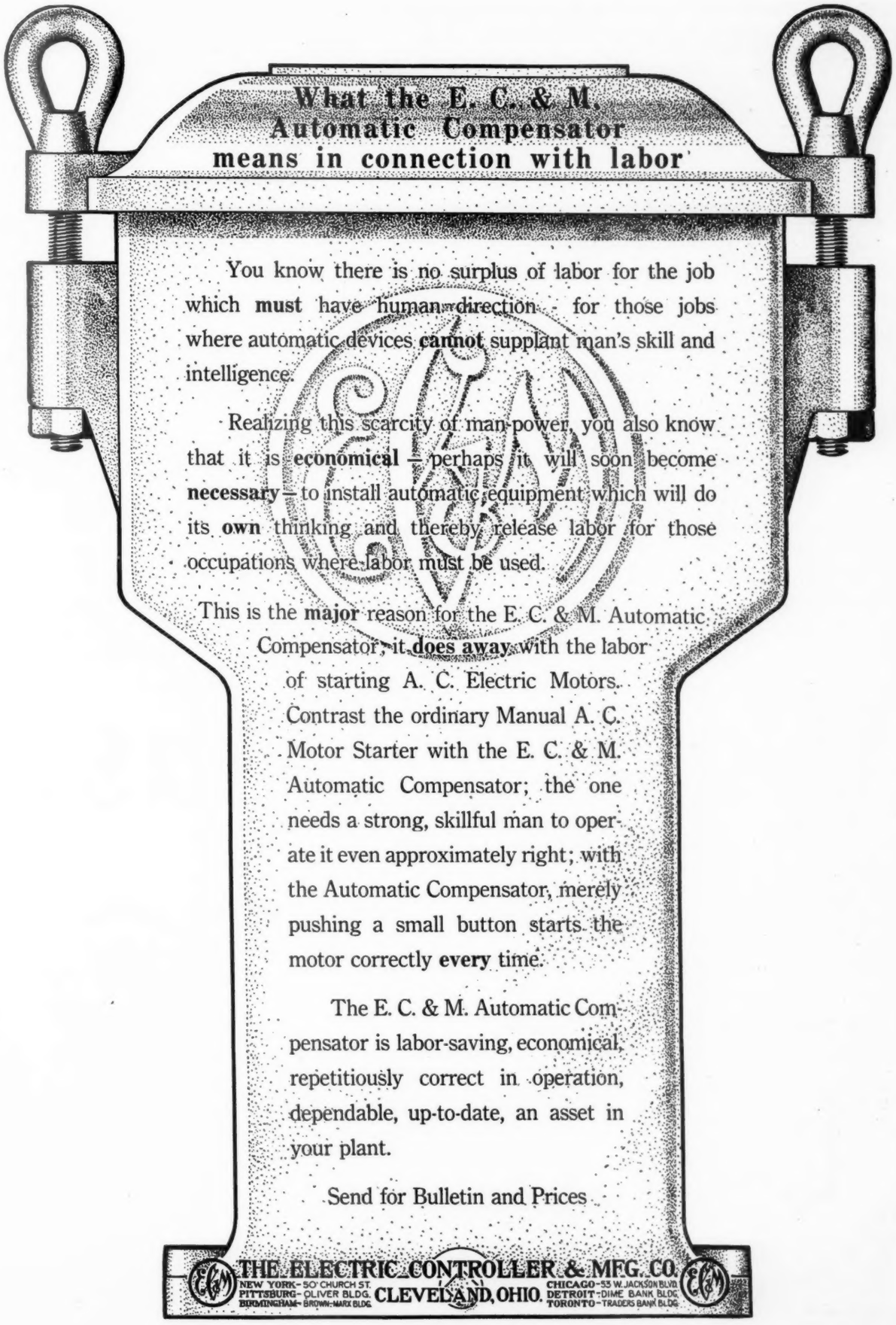
Sets of the following sizes are now ready: ⅜", ½", ¾", 1", 1¼".

MECHANICAL SPECIALTIES CO.

Peoples Gas Building

Wrench and Tool Manufacturers

CHICAGO, ILL.



What the E. C. & M. Automatic Compensator means in connection with labor

You know there is no surplus of labor for the job which **must** have human direction - for those jobs where automatic devices **cannot** supplant man's skill and intelligence.

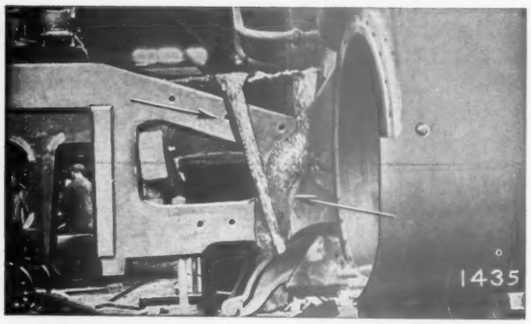
Realizing this scarcity of man-power, you also know that it is **economical** – perhaps it will soon become **necessary** – to install automatic equipment which will do its **own** thinking and thereby release labor for those occupations where labor must be used.

This is the **major** reason for the E. C. & M. Automatic Compensator; it **does away** with the labor of starting A. C. Electric Motors. Contrast the ordinary Manual A. C. Motor Starter with the E. C. & M. Automatic Compensator; the one needs a strong, skillful man to operate it even approximately right; with the Automatic Compensator, merely pushing a small button starts the motor correctly **every** time.

The E. C. & M. Automatic Compensator is labor-saving, economical, repetitiously correct in operation, dependable, up-to-date, an asset in your plant.

Send for Bulletin and Prices

THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, OHIO.
NEW YORK - 50 CHURCH ST.
PITTSBURG - OLIVER BLDG.
BIRMINGHAM - BROWN-MARX BLDG.
CHICAGO - 53 W. JACKSON BLVD.
DETROIT - DIME BANK BLDG.
TORONTO - TRADERS BANK BLDG.



Thermit Weld 19 Inches Long Was Made on Engine Frame and Part of Cylinder Saddle by the Southern Railway.

Keep Your Locomotives On the Run

They Were Never of Greater Value to the Country Than They Are Now.

They are not doing the country any good, however, if they are standing idle in the shop.

Thermit keeps them out of the shop where they can be of real use. Thermit saves weeks of delay in welding frames as it enables you to make a weld without dismantling the locomotive. It is an old saying that "time is the essence of railroading" and we might add that "Thermit is part of the essence."

Full details and prices are given in our pamphlet No. 2151.

GOLDSCHMIDT THERMIT CO.

The Equitable Bldg., 120 Broadway, New York City

329-333 Folsom St., San Francisco; 103 Richmond St., W., Toronto, Ont.; 7300 So. Chicago Ave., Chicago; 1427-1429 Western Ave., Pittsburgh, Pa.

Here's Protection Against Interrupted Cutting and Welding

With your own equipment of the new **I. O. C. Type 4-1000 Unit Generators,** you'll get not only the purest, most efficient gases at a saving of 60% in cost—you'll get also an uninterrupted supply of these gases, under your own control, ample for your needs, always available.

You'll be free from the delays and losses which so often follow interruptions in the supply of gas in cylinders.

You'll be independent—you'll always be sure of speed and efficiency in your operations using gas.

Write for the Type 4-1000 *Bulletin.*

INTERNATIONAL OXYGEN COMPANY

115 Broadway New York

London: Arthur Lyon & Wrench Ltd., Caxton House, S. W.

Westinghouse

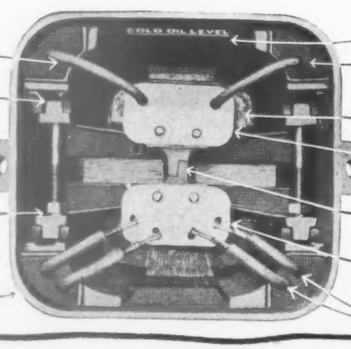
Do not overlook these points of superiority of Westinghouse Transformer Construction.

Type S Transformers are simple and rugged in construction

For instance, solid barriers of Mica-Micarta Insulation are used between windings. This exclusive Westinghouse feature insures a degree of dependability exceeded by no others, guaranteeing that CERTAINTY OF OPERATION which is so important.

The cut below describes some of the features which make Westinghouse Transformers convenient to handle, install and inspect.

Westinghouse Electric & Manufacturing Co.,
East Pittsburgh, Pa.


COLD OIL LEVEL
High-Voltage Lead of treated-cloth braid-covered cable.
Wedges, pressed down by Bolt, grip end-frames and tapered lugs holding coils and iron firmly in tank.
Cored Lifting Lug.
Lock Washer prevents nut from turning.
X33488
Joint of regular contour between tank and cover maintains gasket in position in groove of cover.
Correct Cold-Oil Level marked inside tank.
Sealing Compound is poured at an angle to drain oil into tank.
Treated-Wood Spacer supports leads between coils and porcelain spacer.
Porcelain Spacer (at oil level) supports and insulates high-voltage leads.
To lift coils and iron out of tank, place hooks under these lugs.
Porcelain Spacer (at oil level) supports and insulates low-voltage leads.
Low-Voltage Leads of treated-cloth braid-covered cable.

"Link Up With Lincoln"

SIMPLICITY HONESTY

Your engineers save steam on light loads by "linking up."

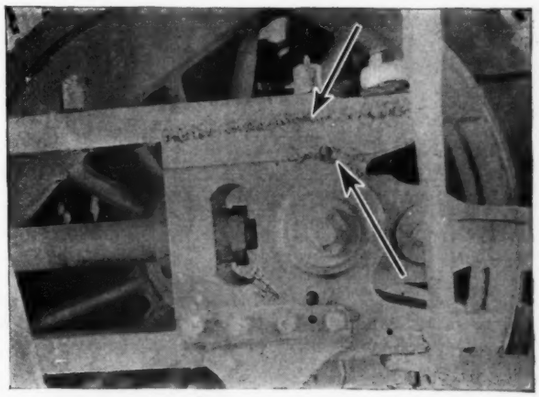
The Lincoln Arc Welder, by automatically "linking up" on its generator voltage, produces only the exact amount of current needed for the job in hand. You save money by using the

Lincoln Arc Welder

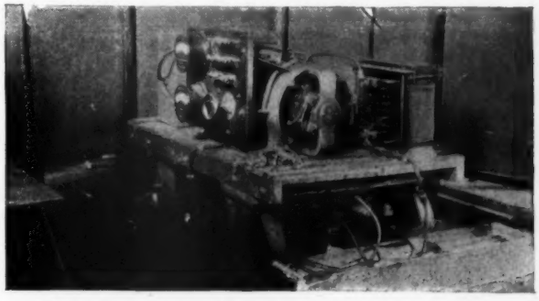
The old system of using resistance ballast to obtain a reliable arc is wasteful. It is "running wide open."

Mr. Wanamaker, of the Rock Island Railroad, says: "Variable Voltage is best." He knows too, for the Rock Island has 23 Lincoln Arc Welders in their repair shops.

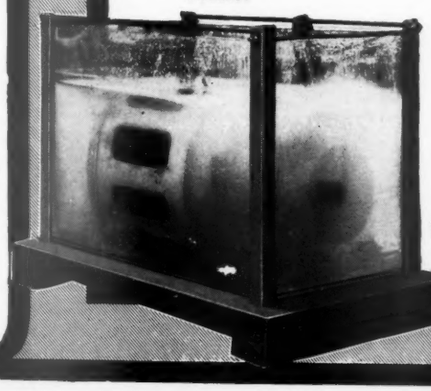
Have you adopted Lincoln Welders? If not, write for our booklet No. 104-G. It gives facts and figures about railroad repair savings. Then ask our Welding Engineer to call and tackle YOUR problems.



Worn Engine Crosshead repaired by welding on piece of boiler plate at the top, and welding crack as shown.



Lincoln Arc Welder (portable type)—one of 23 in use on the Rock Island R. R. Note the absence of cumbersome and wasteful ballast resistances and the extreme simplicity of the outfit.



THE LINCOLN ELECTRIC CO.

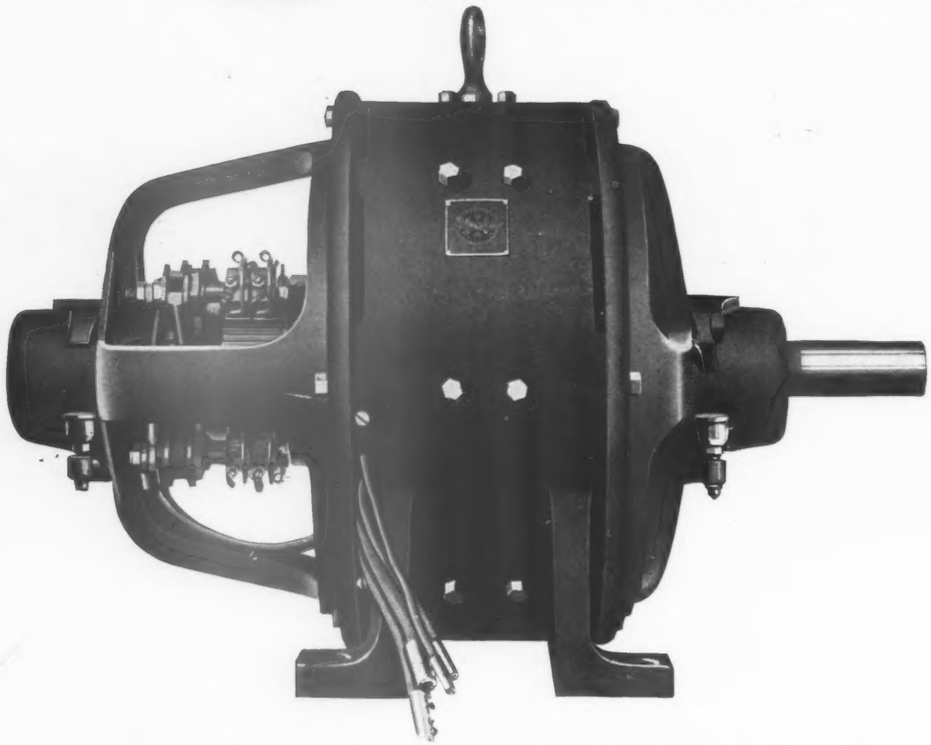
CLEVELAND, O.

New York City	Chicago	Philadelphia
Buffalo	Columbus	Charlotte, N. C.
Syracuse	Detroit	Toronto
Boston	Pittsburgh	Montreal

Agencies in Other Principal Cities

Type T Heavy Duty RELIANCE MOTORS

Direct Current



We went after first hand facts before designing Type T Motors

Thirty-five Electrical Engineers in the largest steel plants and machine shops showed us just where weak spots in motors were revealed in their work. They told us what the motors must stand and what from their experience was necessary to overcome their difficulties.

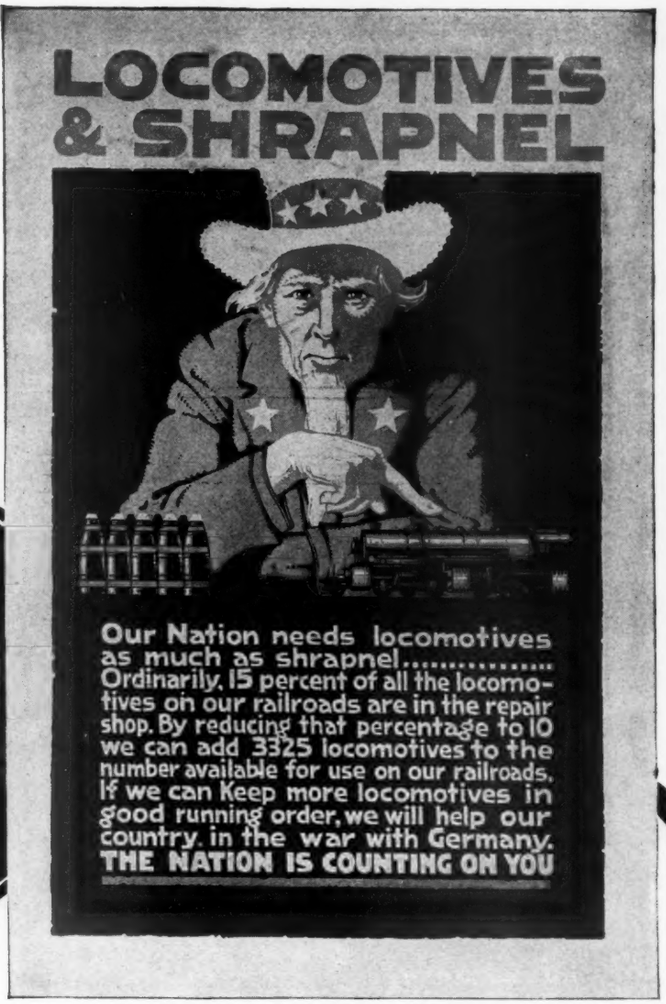
Every motor detail was considered from the standpoint of service. The result is a heavy duty motor which represents the combined ideas of these thoroughly practical men who know the need for quality and strength in every motor detail from shaft to eye bolt. No motor could be more thoroughly the result of recommendations and criticisms from men in the field whose needs it is intended to meet.

Read our Bulletin 2014 and see if this isn't the kind of motor you want.

Reliance Electric & Engineering Co.

1084 Ivanhoe Road **Cleveland, O.**

Branch Sales Offices: New York, 90 West St.; Philadelphia, Harrison Bldg.; Pittsburgh, Arrott Bldg.; Chicago, Fisher Bldg.


LOCOMOTIVES
& SHRAPNEL
Our Nation needs locomotives as much as shrapnel.....
Ordinarily, 15 percent of all the locomotives on our railroads are in the repair shop. By reducing that percentage to 10 we can add 3325 locomotives to the number available for use on our railroads. If we can keep more locomotives in good running order, we will help our country in the war with Germany.
THE NATION IS COUNTING ON YOU

Our Nation Needs Locomotives as Much as Shrapnel

The rail transportation system of this country is so vast in its proportions, that in normal times there are from four to five thousand locomotives—or practically 15% in the repair shops. It is estimated that if this percentage could be reduced to 10, over three thousand locomotives would be made available. How **vastly important** then is **the repair problem.** Today every industry is taxed to its capacity, and repair parts cannot always be obtained promptly. The importance of The Westinghouse Arc Welding Outfit as a means of making lasting repairs quickly and economically, cannot be overestimated. It is a simple and reliable way of making hundreds of miscellaneous repairs. The Westinghouse Arc Welding Set is a conserver of both time and material and enables you to get maximum service from your rolling stock.

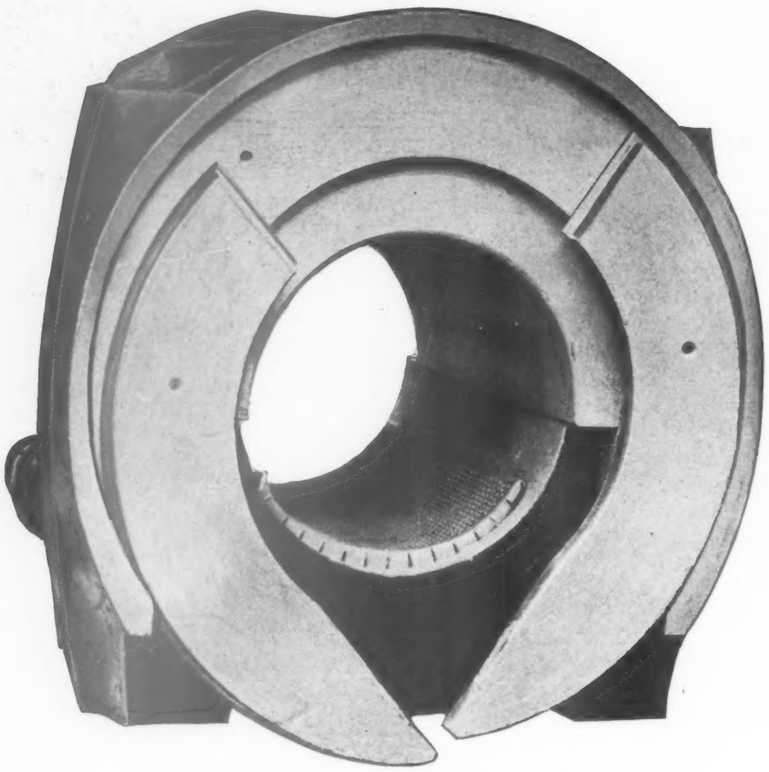
Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

W
WESTINGHOUSE ELECTRIC

Westinghouse

Four Hours' Time on Any Side Track is Enough to Refit Brasses and Take Up Lateral



THE KEYSTONE DRIVING BOX
Showing Hub Liners

A machinist and one helper can refit brasses and take up the lateral in Keystone Boxes in four hours' time *or less*—and *on any side track.*

To put the engine over the pit means three days or more loss of service and five times as much cost for labor.

Many an engine has been sent to the back shop for general repairs simply because brasses and lateral could not be taken care of in time.

* * *

Keystone Boxes can be made from the boxes now on your engines and at small cost compared to the service rendered.

Now that every available engine must be kept in service you can't afford to be too conservative.

Ask for blue-prints and judge for yourself.

KEYSTONE EQUIPMENT COMPANY

825 Walnut Street **Philadelphia, Pa.**

Here's the new RF Adjustable Speed motor →

This is what it will do ←

Operate successfully in either direction as a motor or as a generator for dynamic braking.

Successfully commutate sudden high peak loads at any speed within its range.

Withstand sudden speed changes due to changes in field resistance.

Stand short circuits, when used for dynamic braking, and when shut down with full voltage left on field does not overheat.

Operates by drum or very simple magnetic control for automatically repeated cycles.

Assure practical freedom from commutator troubles arising from abuse or careless operation.

Show ample capacity as it is rated by test equivalent to all day load conditions met in actual service.

Complete information on this new type of motor can be obtained from Bulletin No. 41021, which will be mailed you on request.

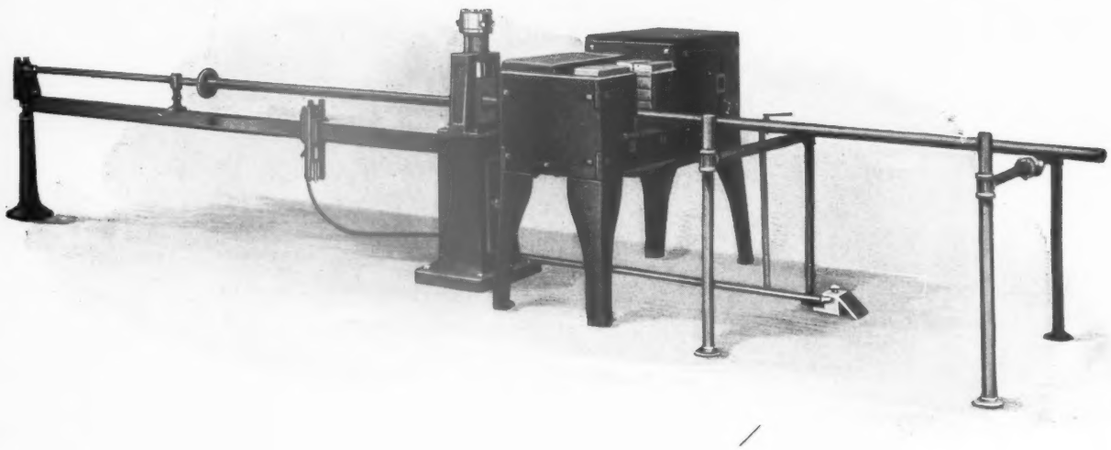
General Electric Company

General Office: **Schenectady, N. Y.**

Sales Offices in all large cities

7323

OLD TUBES ARE TOO EXPENSIVE TO SCRAP



SHORT TUBES WELDED TO PROPER LENGTH

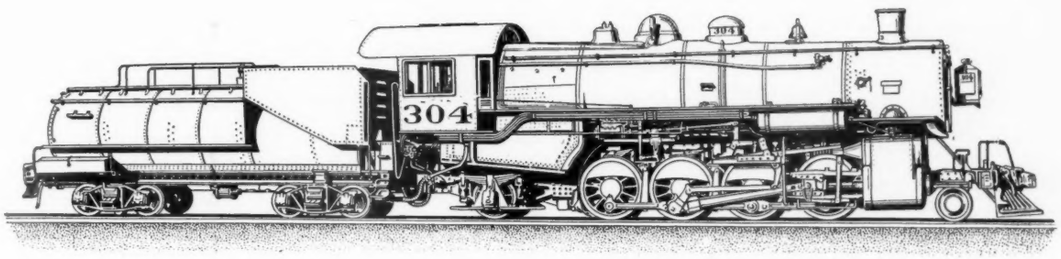
The Ryerson Boiler Tube Reclaiming Machine is not only a highly efficient flue reclaiming unit but also standard equipment for the regular safe-ending operations.

Use all the material you have — two or three short lengths of tubes can be welded to make full length tubes and thus utilize all scrap material for good service.

The whole operation is so simple that any workman can do the job. Special machines can be furnished for special purposes.

JOSEPH T. RYERSON & SON

CHICAGO ST. LOUIS DETROIT NEW YORK



Superheat Does More Than Save Coal, It Increases the Ton Mile Capacity of the Entire Railroad.

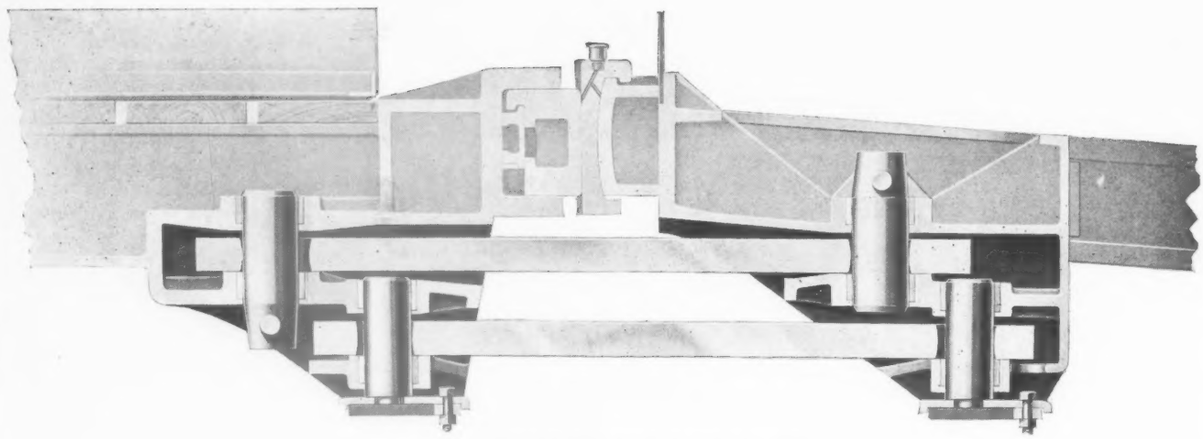
AUSTRALIAN LINES ADOPT SUPERHEATERS

"W. M. Shannon, the chief mechanical engineer, Victorian Government Railways, said that the adoption of superheaters should save 12½ per cent of the fuel consumption, and had 200 of the locomotives on the Victorian railways been equipped with superheaters there would have been a saving last year, when coal was $3.80 per ton, of $55,300. At present coal was $5.06 per ton, and, therefore, there would have been a saving of $82,620."

Railway Age Gazette, October 26, 1917.

LOCOMOTIVE SUPERHEATER CO.

New York Chicago



A SAFE ENGINE-TENDER CONNECTION

MODERNIZE

A real safety bar must be on the center line of the engine. Of course it must.

This is why:

Safety chains and slotted bars must be slack to provide for curving.

If the draw bar breaks the "stretch out" of slack snaps the chains or bars. They can't be made strong enough.

A unit safety bar located on the center line has just enough clearance to keep the load on the main bar.

This is why it is safe.

Franklin Railway Supply Company, Inc.

30 CHURCH STREET NEW YORK

332 So. Michigan Avenue Chicago

625 Transportation Building Montreal

Arch engines come through with 200 pounds of steam

THE WORLD WILL BE CHANGED IN THE NEXT FEW MONTHS

Add a lot to the worst winter in history.

There's never been one like the one that's coming.

Our responsibilities are very clear to us.

We're prepared to improve firebox conditions.

To increase the power of the fire.

200 pounds boiler pressure will mean everything to everybody next winter.

Troop trains, ammunition trains, supply trains and winter will come together.

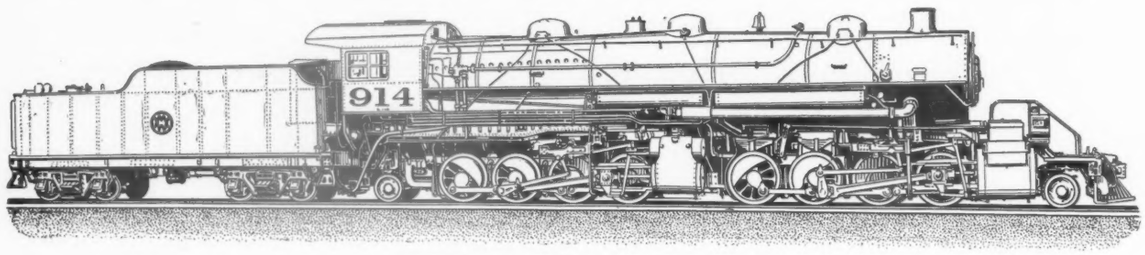
There's no time to lose.

AMERICAN ARCH COMPANY

Specialists in Locomotive Combustion

McCormick Bldg.
Chicago

30 Church Street
New York



WESTERN MARYLAND MALLET

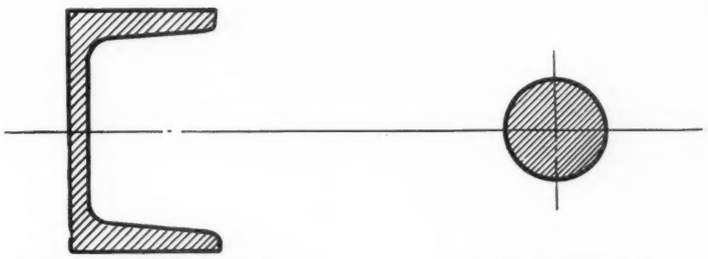
"How much has already been accomplished in the matter of larger and larger units of power is evident from a comparison of the horse-power output of a typical first class locomotive built about 1904-05 and that of one of recent design. In 1904 we were obtaining from our best designs of simple locomotives about 1100 to 1200 i. hp. per hour from 5000 lb. of coal. Today we are obtaining from the same amount of coal about 2000 to 2100 i. hp. per hour."

W. E. WOODARD, Vice President
Lima Locomotive Works, Incorporated
Journal of American Society of
Mechanical Engineers

Lima Locomotive Works, Inc.

Lima, Ohio

30 Church Street New York



One Construction

Channel compression member—round tension member; the most satisfactory type of construction for a trussed brake beam.

Ajax and Hercules brake beams have but one type of construction. Both channels and rods are of open-hearth steel, made to rigid specifications and carefully inspected by American Steel Foundries.

AMERICAN STEEL FOUNDRIES

New York Chicago St. Louis

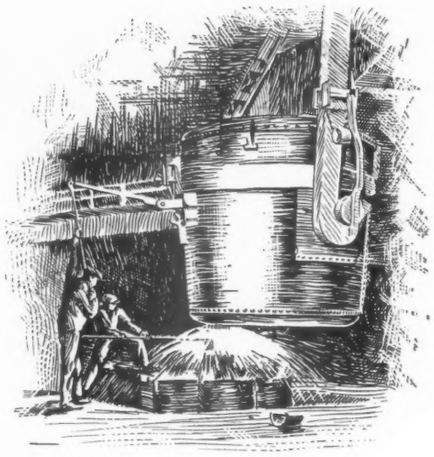
When Anyone Mentions

Firebox Steel

You Just Naturally

Think of

Lukens



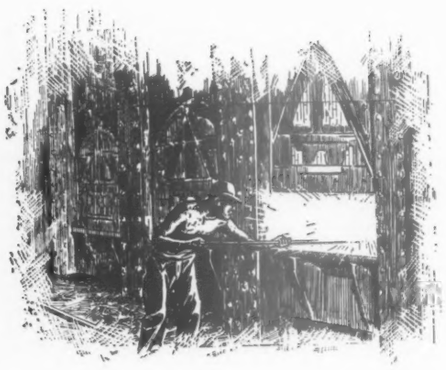
When Anyone Mentions

Lukens

You Just Naturally

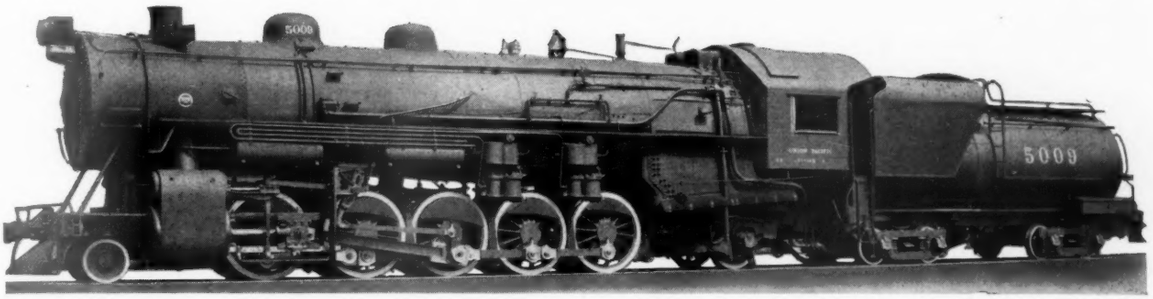
Think of

Quality



R

A NEW SANTA FE TYPE



Santa Fe Type Locomotive for the Union Pacific R. R.
C. E. Fuller, Supt. Motive Power and Machinery.

CYLINDERS—29½ x 30 inches.
DRIVING-WHEELS, DIAM.—63 inches.
STEAM PRESSURE—200 lbs.
GRATE AREA—84 sq. ft.
WATER HEATING SURFACE—5,152 sq. ft.
SUPERHEATING SURFACE—1,262 sq. ft.
WEIGHT ON DRIVING-WHEELS—285,500 lbs.
WEIGHT, TOTAL ENGINE—357,600 lbs.
TRACTIVE FORCE—70,450 lbs.

The Union Pacific has recently adopted the Santa Fe type for heavy freight service on mountain grades. These engines are a development of the Mikado type locomotives used on this road for freight and mountain passenger service. Interchangeable details are used in the two types where practicable. Both classes are equipped with superheaters, arches, and power reverse gears, and the Santa Fes are fired with mechanical stokers.

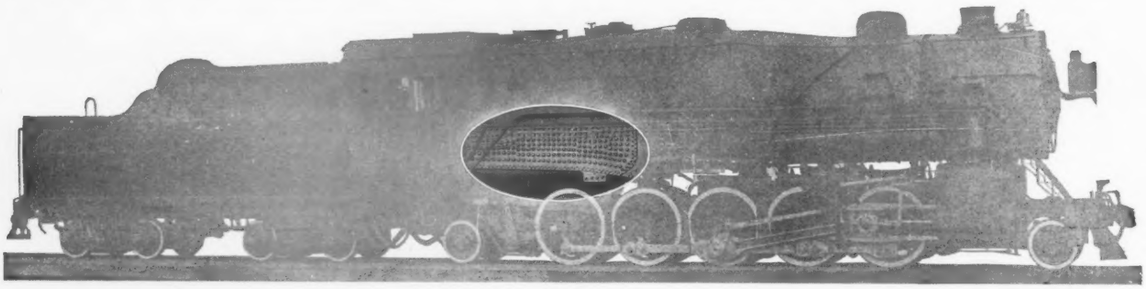
Santa Fe type locomotives are specially fitted for handling freight traffic on steep grades. When properly designed and equipped for the service, these large units are efficient and reliable in operation and can develop power up to their full theoretical capacity.

THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA, PA., U. S. A.

Represented by

F. W. Weston, 120 Broadway, New York, N. Y.
Charles Riddell, 627 Railway Exchange, Chicago, Ill.
C. H. Peterson, 1210 Boatmen's Bank Bldg., St. Louis, Mo.
George F. Jones, 407 Travelers Building, Richmond, Va.
A. Wm. Hinger, 512 Northwestern Bank Bldg., Portland, Ore.
Williams, Dimond & Co., 310 Sansome St., San Francisco, Cal.

Cable Address: "BALDWIN, PHILADELPHIA."



BREAK-LESS STAYBOLTS

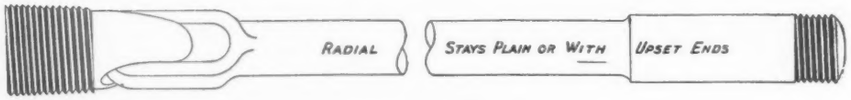
are among the many notable features of equipment on this locomotive. It represents the latest practice in modern design and is the result of the best thought of locomotive designers and builders.

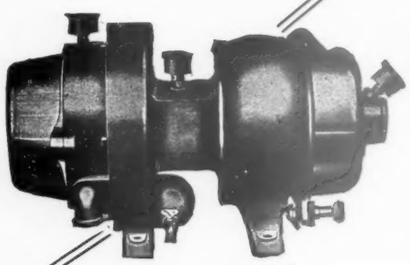
These staybolts not only provide a bolt which from a mechanical standpoint is ideal on account of its simplicity and strength, but they also improve firebox construction due to the fact that they remain flexible at all times without the complications of sleeves and caps, and that their application does not structurally weaken the firebox.

Write for Descriptive Pamphlets.

The Breakless Staybolt Company

Pittsburgh, Pa.





Type RE-2 32 Volt

Survival of the Fittest

The first successful incandescent headlight was built five years ago. It was a

"SCHROEDER"

So completely successful for all requirements that no change has been found necessary in the design or principle of the RE-2

"SCHROEDER"

Close speed regulation with low steam consumption, and maximum light with the minimum of maintenance are embodied in the

"SCHROEDER"

Time tried and service tested

"SCHROEDER"

Truly a One Standard Equipment

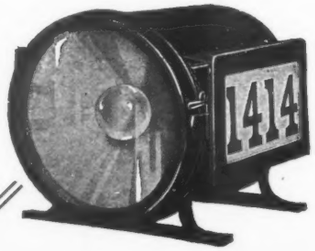
"The Light That's Right"

Schroeder Headlight Co.

Headlight Makers for 30 Years

EVANSVILLE - - INDIANA

Glass Reflector needs no replating—no repolishing —lasts indefinitely.



A Business Trip With A Railway President

THE SECOND SCENE IN A DRAMA OF MODERN ENGINEERING

"Facts are facts and what I am going to have are the facts concerning our high cost of Maintenance of Equipment."
Pres. "Y"

CHARACTERS

President Y. of the U. N. P. & B. Ry.....A Man of Action
Abel Mann .....Vice-Pres. of U. N. P. & B. Ry.
Jack M. Upp .....Gen. Mgr. of U. N. P. & B. Ry.
X. Haust Pipe .....Supt. M. P. of U. N. P. & B. Ry.
Tubel Scale .....Master Mech. of U. N. P. & B. Ry.
M. U. D. Ring.....A Colored Messenger

AND

P. E. ROLIN ..... EXPERT ON BOILER METAL TREATMENT

Time: Right Now Place: Office of President "Y"

PRES. "Y"— "But the Net Income, Mann, that's the point. Our operating revenues are most satisfactory; the high peak of the traffic during the last six months assured that. Our gross income—it's the best showing we've ever had. But the net, it's not what it should be, Abel, on that volume of business. Operating expenses strike me as high. For instance, take Maintenance of Equipment. There is a bigger hump in the curve there, than I like to see."

ABEL MANN— "That's the way it struck me, yet the Supt. of Motive Power and——"

PRES. "Y"— "The make up of our entire organization is the best. I'm proud of our men, Abel, but—there is that net income, and facts are facts, and what I am going to have are the facts concerning our high cost for Maintenance of Equipment."

ABEL MANN— "Here are some figures I have tabulated from detailed reports of our Motive Power Department, they——"

PRES. "Y"— "Are all right, no doubt, but—look here, Abel, at page 52 of *Railway Age Gazette,* August 31st; that page decided me to do what railroad presidents do not often do—get right out on the road and study actual conditions and methods, ask questions and see what I can see. Not because I doubt the ability of our officials — far from it, but to find out if there is truth in the saying 'familiarity breeds contempt"—especially contempt for methods which will reduce operating costs and bring that "Net" up to where you and I feel that it should be."

You are invited to accompany Pres. "Y" on his business trip, a trip which brought information which enabled him to reduce the hump in the Maintenance of Equipment Curve. How? Follow this page monthly; do as Pres. "Y" did—see for yourself.

Perolin The Boiler Metal Treatment

We maintain a service department of Mechanical Experts. If, like Pres. "Y" you desire to bring Maintenance of Equipment Costs down, this department is at your service

Perolin Railway Service Company

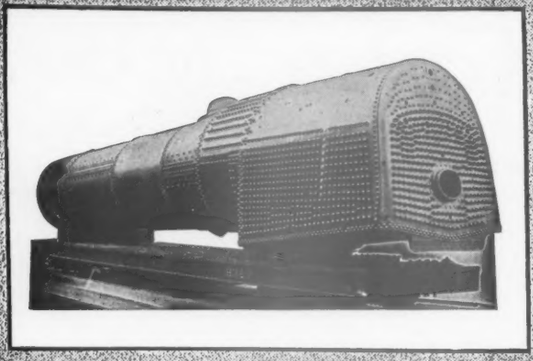
Charles M. Viley, President, Railway Exchange Building, St. Louis

John D. Ristine, Manager of Sales
Peoples Gas Building
Chicago

Eastern Office
Woolworth Building
New York

G. F. Cotter Supply Company
Southwestern Representatives
Southern Pacific Building, Houston

Copyrighted by The Perolin Ry. Service Co., 1917



TATE FLEXIBLE STAYBOLTS

THE RECOGNIZED STANDARD FOR LOCOMOTIVE FIREBOXES

SERVICEABILITY PLUS ECONOMY

The Tate Bolt has fully demonstrated its true functions as a mechanical appliance to serve the firebox requirements. Flexibility must be maintained—the only positive assurance of flexibility is the use of the Tate Flexible Staybolt.

Many of the largest railroad systems have kept accurate service records and show remarkable increase in earning power of the locomotives that have been equipped with complete installations of the Tate Flexible Staybolt.

1

Flannery Bolt Company

PITTSBURGH, PA., U. S. A.

GEN'L OFFICES, VANADIUM BUILDING B. E. D. STAFFORD, GEN'L MANAGER

J. ROGERS FLANNERY & COMPANY, SELLING AGENTS

VANADIUM BUILDING, PITTSBURGH, PA.

GEO. E. HOWARD, EASTERN TERRITORY W. M. WILSON, WESTERN TERRITORY

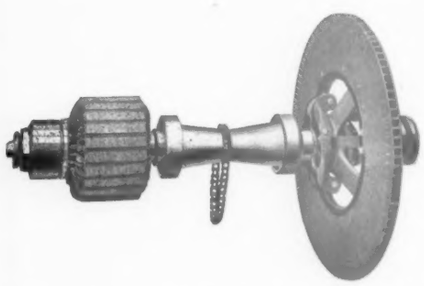
COMMONWEALTH SUPPLY CO., SOUTHEASTERN TERRITORY

CHARLES HYLAND, BOILER EXPERT

THE LOCO LIGHT

INCANDESCENT HEADLIGHT EQUIPMENT

Simple, Sturdy Construction Insures Years of Service



Rotating Assembly, Showing Turbine Wheel, Governor, Oiling System and Armature.

The Loco Light Turbo Generator is simple in construction, efficient, economical and dependable under all conditions. *"Will give satisfactory service for many years."*

Has full ball bearing construction—no packings are used—friction is reduced to a minimum.

Automatic oiling system gives continuous lubrication to bearings and all working parts. *"One filling of oil-well lasts two months."*

Positive Automatic Governor maintains same voltage at all times —saves lamps.

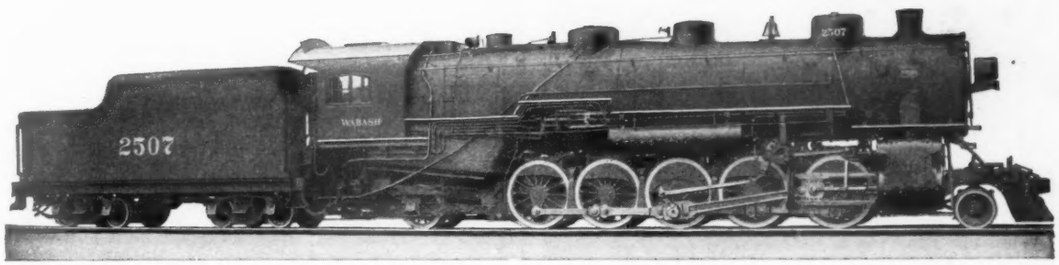
Electrically efficient with large overload capacity.

Low first cost—low maintenance cost—guaranteed against repairs for one year.

Before making any additions our headlight equipment, it will pay you investigate the LOCO LIGHT—catalog sent upon request.

THE LOCO LIGHT COMPANY, Indianapolis, Ind.

WABASH RAILWAY



Total Weight of Engine, 395,000 pounds; Weight on Drivers, 314,000 pounds; Diameter of Drivers, 64 inches; Boiler Pressure, 195 pounds; Cylinders, 29x32 inches; Maximum Tractive Power, 69,700 pounds.

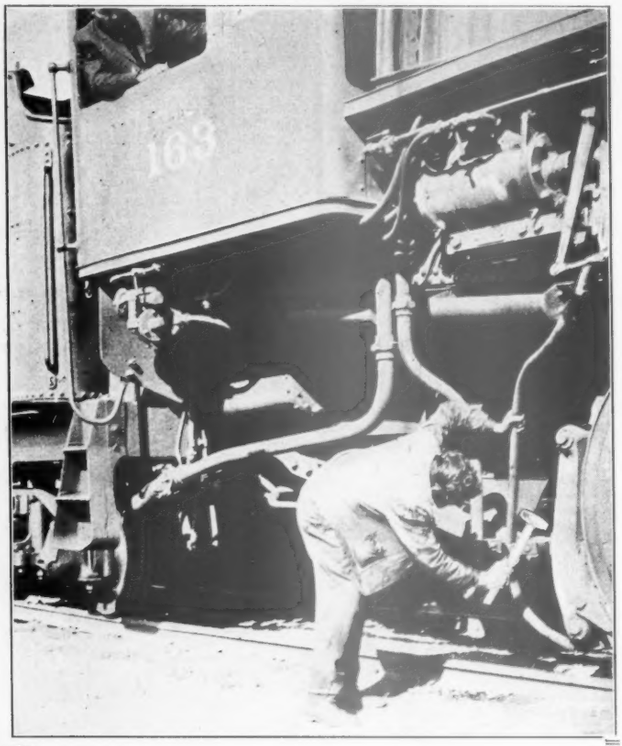
These engines are being operated on the Decatur division from St. Louis to Chicago. The ruling grade Northbound, the direction of the heaviest traffic, is 0.4 per cent and the length of the longest single grade is four miles.

The average Northbound train handled by these 2-10-2 type engines is 5000 tons as against 3500 tons previously handled by Mikados.

The Mikados have cylinders 26x30 inches and a total weight of engine of 267,000 pounds.

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET, NEW YORK

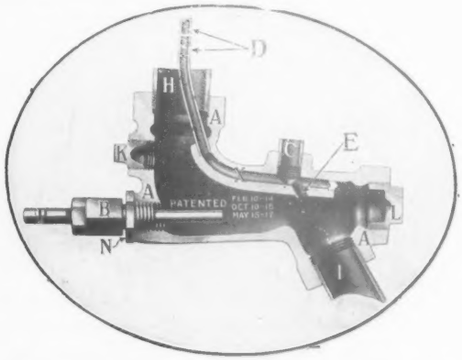


LOSING $50 A MINUTE

Many railroad officers agree that $50 a minute is a moderate estimate of the loss caused by engine failure on an important train. Then will you hesitate to pay a few dollars more per locomotive for the Graham-White Perfect Sander—the self-cleaning sander that eliminates sand failures.

Is your hesitation due to doubt that this sander will eliminate failures?

If so, don't take our word for it that the "Graham-White will solve the sander problem, but let us show you by a test that costs you nothing and imposes no obligation.



White American Locomotive Sander Company, Inc.

ROANOKE VIRGINIA

The Early Start

"MY enemies," said Napoleon Bonaparte, the military genius, "did not know the value of five minutes."

Ask some prominent manufacturer how he maintains his lead in the face of keen competition.

He will tell you that he started to advertise early in the game; that long before other firms realized the wonderful pulling power of striking advertisements, he had taken his first steps.

If you have a commodity that railways should use, make an early start into the advertising field. The day will come when your lead will demonstrate that an early start was the beginning of your success.

Railway
Mechanical
Engineer

A Satisfactory Water Treatment

must convert the water supplies on the division into **good steam water**,—that is,—must correct their tendencies to corrosion and foaming,—and prevent the incrusting salts from depositing as scale. This must be done without developing any detrimental by-products;—scale must be prevented without creating a foaming condition;—all corrosive salts must be counteracted.

Your good judgment will tell you that this is a job for chemists—men with scientific knowledge of the chemistry of water, as well as practical knowledge of operating conditions.

Let your good judgment also tell you whether it is possible to coat the boiler metal with any substance that will withstand the attacks of the average raw water, in the degree of concentration found in a locomotive boiler.

Scientifically combined reagents for the mineral salts in the water supplies constitute the only satisfactory solution of the "bad water" problem.

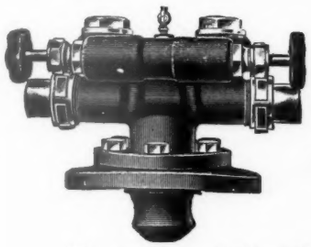
Let us demonstrate the truth of our argument.

DEARBORN METHODS ORIGINATED IN AMERICA. Dearborn Treatment is used all over the world.

DEARBORN CHEMICAL CO.
McCormick Building Chicago

1

Double Boiler Check Valve



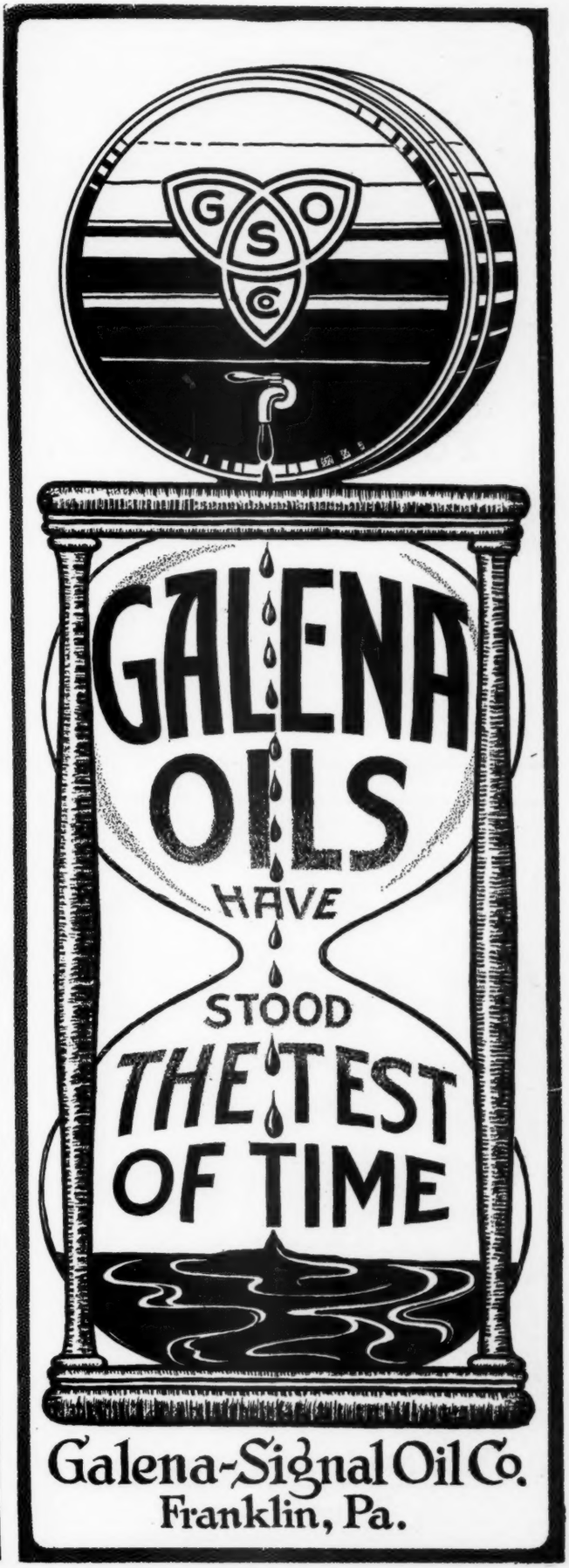
The position of this valve is on top of the boiler. It is provided with a stop valve for each check valve, so that either one of the check valves, if out of order, may be "cut out" without interfering with the feeding of the boiler. Removable caps on top of each check permit inspection and grinding of valves without disconnecting pipes.

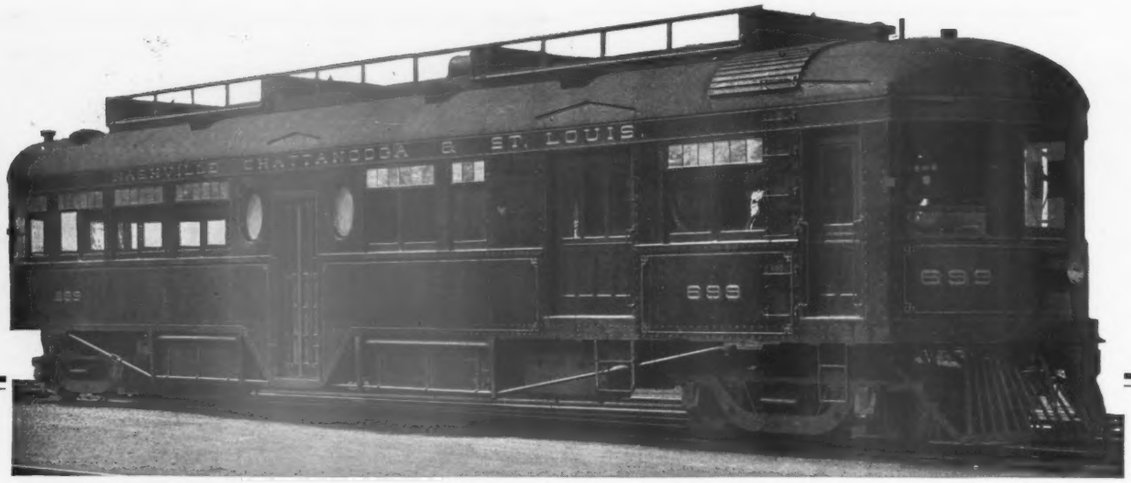
Simple and pleasing design, compact and efficient. Furnished complete with boiler flange.

Write for Catalog

NATHAN MANUFACTURING CO.
FLUSHING, L.I. NEW YORK

Western Office: 1612 Old Colony Building, Chicago
St. Louis Office: Frisco Building





For Your Branch Line Service

Branch Line Service is nearly always a losing game. But it shouldn't be. This is what the *Railway Mechanical Engineer* says about the

BEACH OIL ELECTRIC CAR

"This car is the most powerful self-propelled car yet constructed. * * * * It is designed to take the place of steam train service on branch lines and small railways where such service is unprofitable. The power plant in the car is of particular interest."

Our engineers will be of assistance in determining where your branch line losses may be made to show profits.

Electric Car and Locomotive Corporation

Ralph H. Beach, Pres.

165 Broadway **New York, N. Y.**

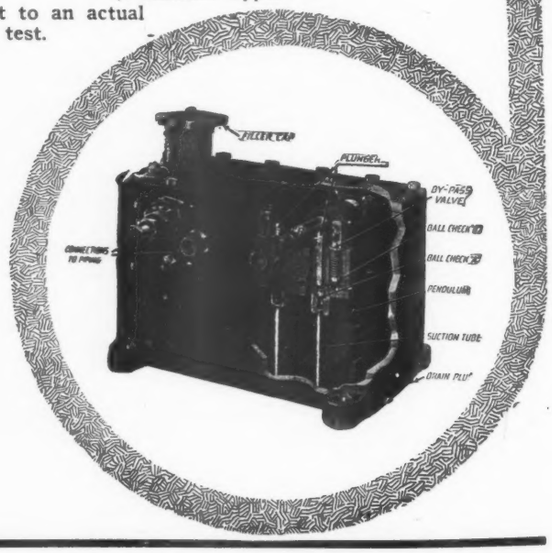
It Stood the Test

Illustration shows an installation of the Detroit Automatic Flange Oiler on a locomotive, type 0-4-0, used in heavy switching service at a prominent railroad terminal. This

Detroit Automatic Flange Oiler

(Pendulum Type)

was put to an actual service test.



Since Dec. 16, 1916, this locomotive has been operated 22 hours daily with the exception of one day each month, when it was in the shop for boiler wash. The flanges on the tires are still in excellent condition, thus proving the economy of flange lubrication and the efficiency of the Detroit Automatic Flange Oiler.

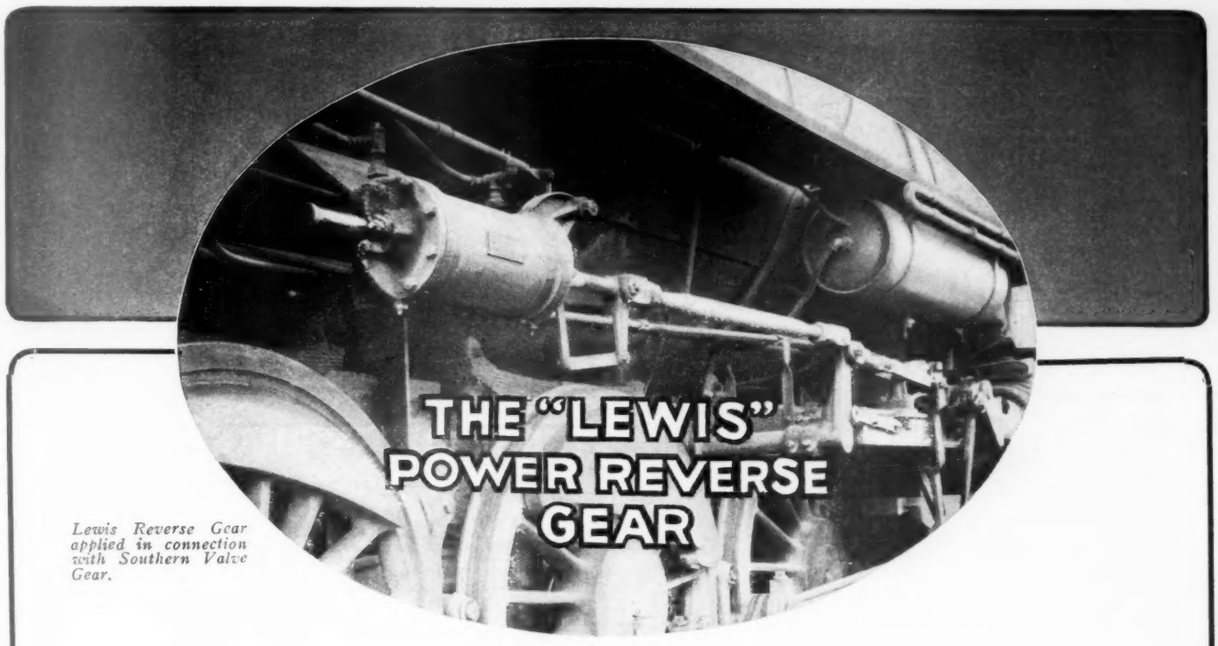
The Detroit Automatic Flange Oiler successfully stood the test

Write for Booklet FO-75. It tells how you can increase tire mileage and decrease tire maintenance.

DETROIT LUBRICATOR COMPANY

DETROIT, U.S.A.

Makers of the Stewart Carburetors.



Lewis Reverse Gear applied in connection with Southern Valve Gear.

All You Can Demand in a Reverse Gear You Find in a "Lewis"

The power reverse gear has come to stay—it has a definite purpose—it meets an important need. Since, to conserve fuel and man power and to lengthen the life of reciprocating parts you **must** have reverse gears, your problem narrows down to the selection of the **right** gear—the gear designed to accomplish the desired results with minimum energy and expense. The Lewis Power Reverse Gear has proved, in actual service, its ability to meet these requirements. Among the features that make it the logical choice, are

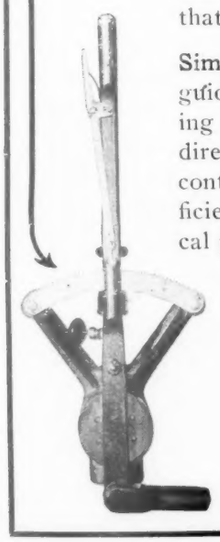
Simplicity—No combination lever—no guide bar or crosshead, as the connecting rod from the reverse shaft couples direct to the piston. Lubrication of control valve and power cylinder is efficient and is controlled from the logical point—the cab.

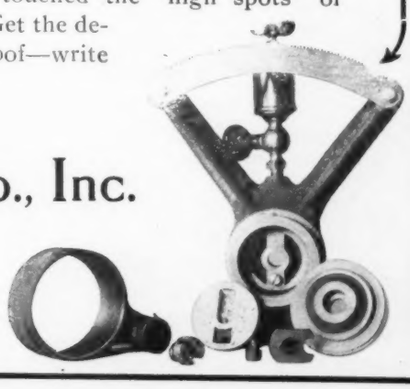
Adaptability—As the control valve and power cylinder are distinct, the cylinder can be placed anywhere to suit conditions. Installing a Lewis is simple and inexpensive.

Sensitiveness and Dependability—There are sixty quadrant positions to each of which the gear promptly responds, giving a very fine adjustment for the cut-off and dependable freedom from creeping.

Maintenance Cost—Practically nil on the "Lewis." In two and a half years of service Lewis Power Reverse Gears have required no repairs.

We have only touched the "high spots" of Lewis merits. Get the details and the proof—write today.





Commonwealth Supply Co., Inc.

Richmond, Virginia

The Railway Materials Company

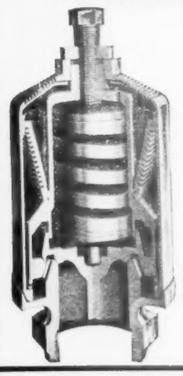
Steel Back Brake Shoes

Railway Exchange CHICAGO

Singer Building NEW YORK

2

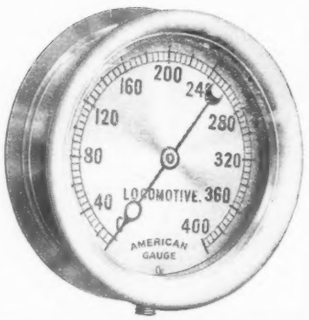
AMERICAN LOCOMOTIVE SPECIALTIES



The New AMERICAN Locomotive Pop Safety Valve. In design entirely original, and the most durable, economical and efficient valve ever known. Will operate perfectly on a 3-lb. blow back.

AMERICAN Special Non-corrosive Air-Brake Gauges, containing heavy seamless drawn tubes, have entire BRONZE movement throughout. We having entirely eliminated the use of brass in these movements, making them practically wear-proof. Guaranteed for five years.

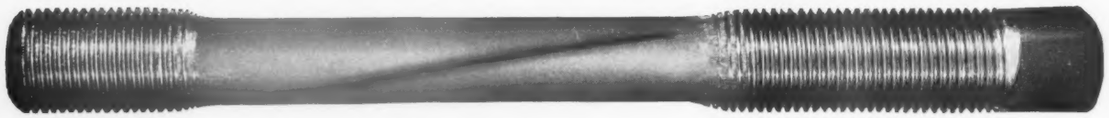
Write for descriptive matter.



American Steam Gauge & Valve Mfg. Co.

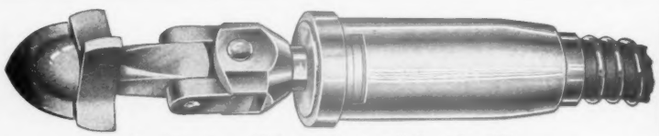
New York Chicago Boston Atlanta Pittsburg

The American Staybolt



American Flexible Bolt Company

Chicago McCormick Bldg. | Pittsburgh Union Bank Bldg. | New York 50 Church Street | Montreal and Winnipeg Taylor & Arnold, Ltd.



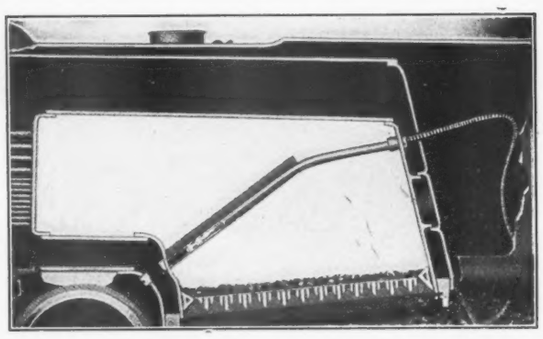
Arch Tube Cleaning Made Easy

Cleaning arch tubes made easy and simple; that is the service performed by the

Roto Arch Tube Cleaner

Operated by a standard 9½ inch air pump

Notice its tapered form which permits it to pass easily around the bends of a 3" arch tube. With the Roto, arch tubes are cleaned much faster than by any other arch tube cleaner. Why? Send for Bulletin No. 44 and get the full answer.



THE ROTO COMPANY, Hartford, Conn.

"Pakring Metal"
Specially Made for Locomotive Castings

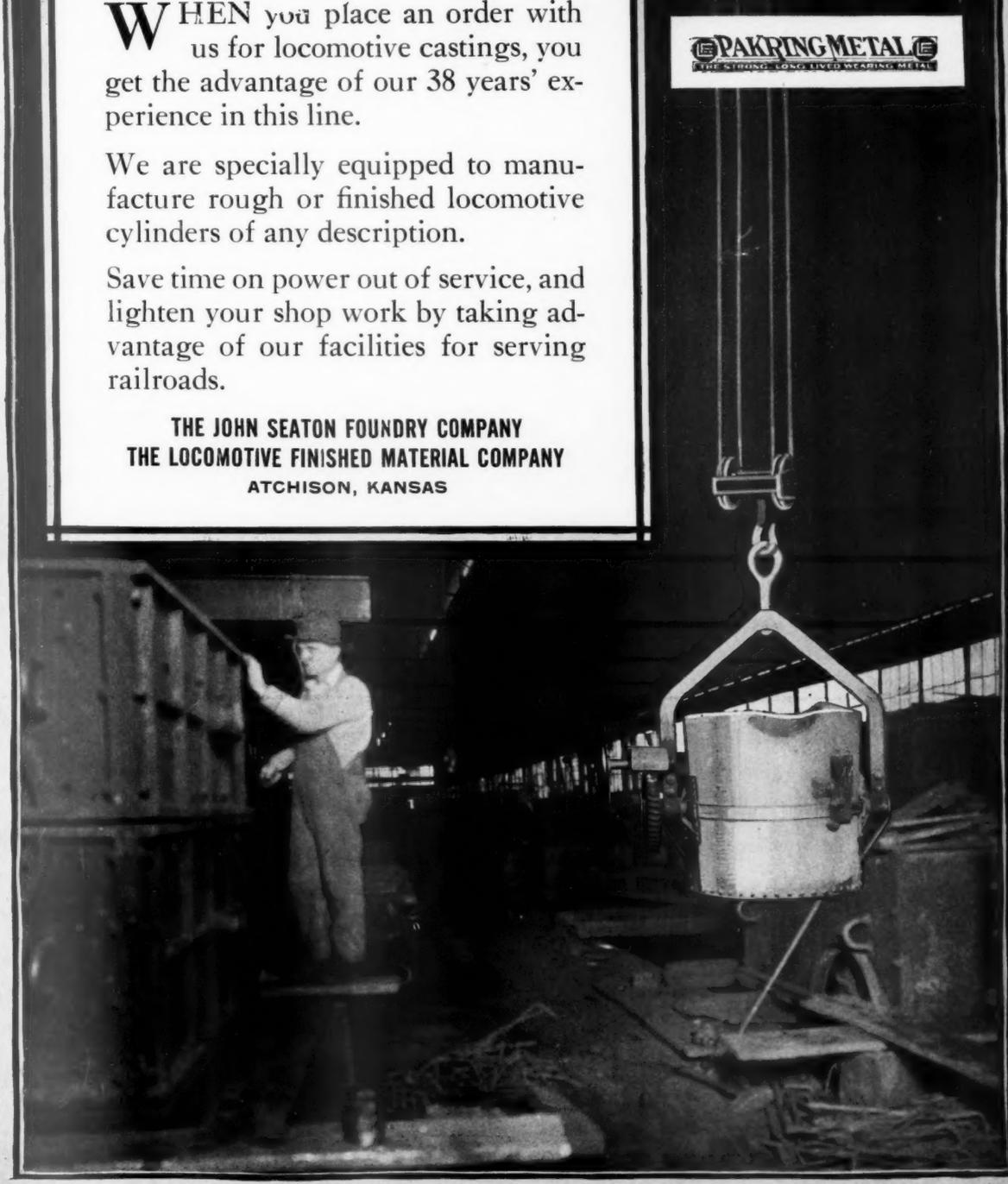
WHEN you place an order with us for locomotive castings, you get the advantage of our 38 years' experience in this line.

We are specially equipped to manufacture rough or finished locomotive cylinders of any description.

Save time on power out of service, and lighten your shop work by taking advantage of our facilities for serving railroads.

THE JOHN SEATON FOUNDRY COMPANY
THE LOCOMOTIVE FINISHED MATERIAL COMPANY
ATCHISON, KANSAS

PAKRING METAL
THE STRONG, LONG LIVED WEARING METAL



F. J. Harrison, Supt. of Motive Power, B. R. & P. Ry.

Since the U. S. Government has caused the Locomotive Builders to give priority to War Orders the Railroads must seek additional power through other channels. They find they can

GET MORE POWER
By Installing
DUPLEX STOKERS

on old engines. The above road is equipping its old engines with Duplex Stokers and at the same time having them applied to its new engines now under construction.

LOCOMOTIVE STOKER CO.

Main Office and Works
PITTSBURGH, PA.

50 Church Street
NEW YORK

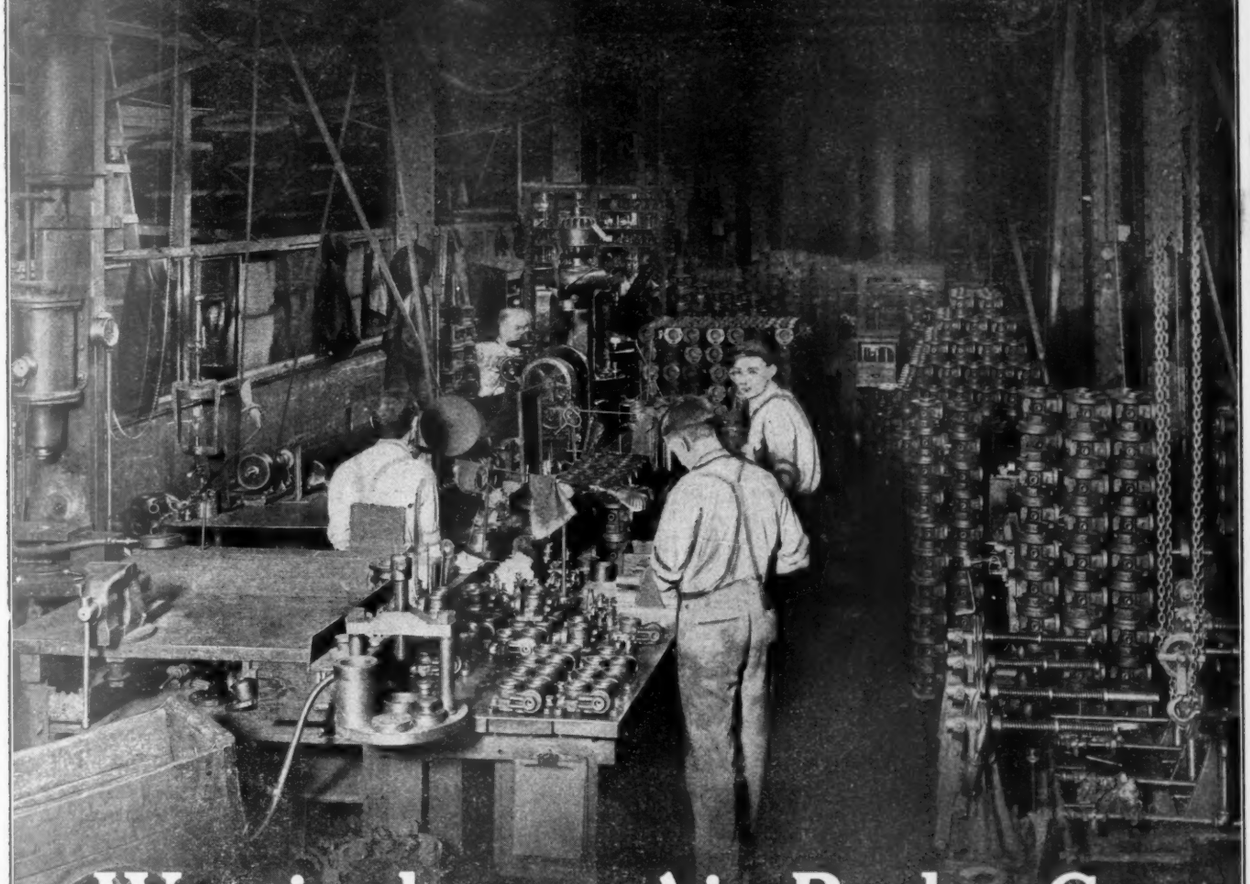
Railway Exchange
CHICAGO

Triple Valve Repair Work

Extensive repairs to triple valves are made more efficiently and economically by the manufacturer because of large volume of work handled, special machinery, scientific organization, complete shop facilities and skilled, trained workmen.

Arrangements exist whereby we make shipment from stock of repaired triple valves in equal number upon receipt of notice by railroad that a shipment of triple valves is being returned to our factory for repairs, thus saving the railroad company the time required to actually make the repairs.

Similarly we handle repairs of feed valves, governors, brake valves and other valvular parts of the air brake. This releases to the railroads manpower for other necessary work consequent upon existing war time conditions.



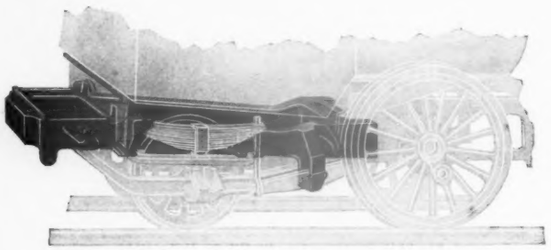
Westinghouse Air Brake Co.

General Office and Works, Wilmerding, Pa.

Atlanta, Ga.
Boston, Mass.
Chicago, Ill.
Columbus, O.
Denver, Col.
Houston, Tex.
Los Angeles,
Mexico City
New York, N.Y.
Pittsburgh, Pa.
San Francisco.
Seattle, Wash.
St. Louis, Mo.
St. Paul, Minn.

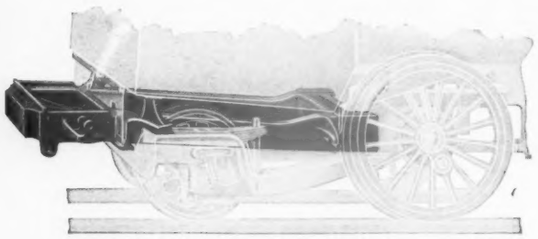
COMMONWEALTH
LOCOMOTIVE CRADLE
(PATENTED)

Combines the rear frame members and the numerous parts heretofore attached to them, in one durable, compact element of greater strength and less weight. Wearing bushings applied. Machined before shipment.



With Cole Type Trailer Truck

USED WITH ANY TYPE OF TRAILER TRUCK



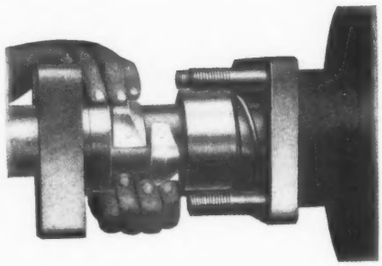
With Delta Type Trailer Truck

Eliminates on each Locomotive:

100 machined bolts with nuts
250 drilled and reamed holes
A large area of machined surface
15 separate pieces and many joints
OVER A TON IN WEIGHT

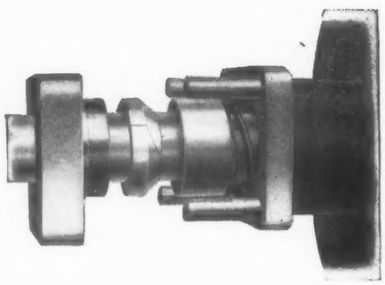
Commonwealth Steel Company
Pierce Building Saint Louis

KING
Metallic Packing



SIMPLE TO APPLY

RING OF ONLY TWO PARTS

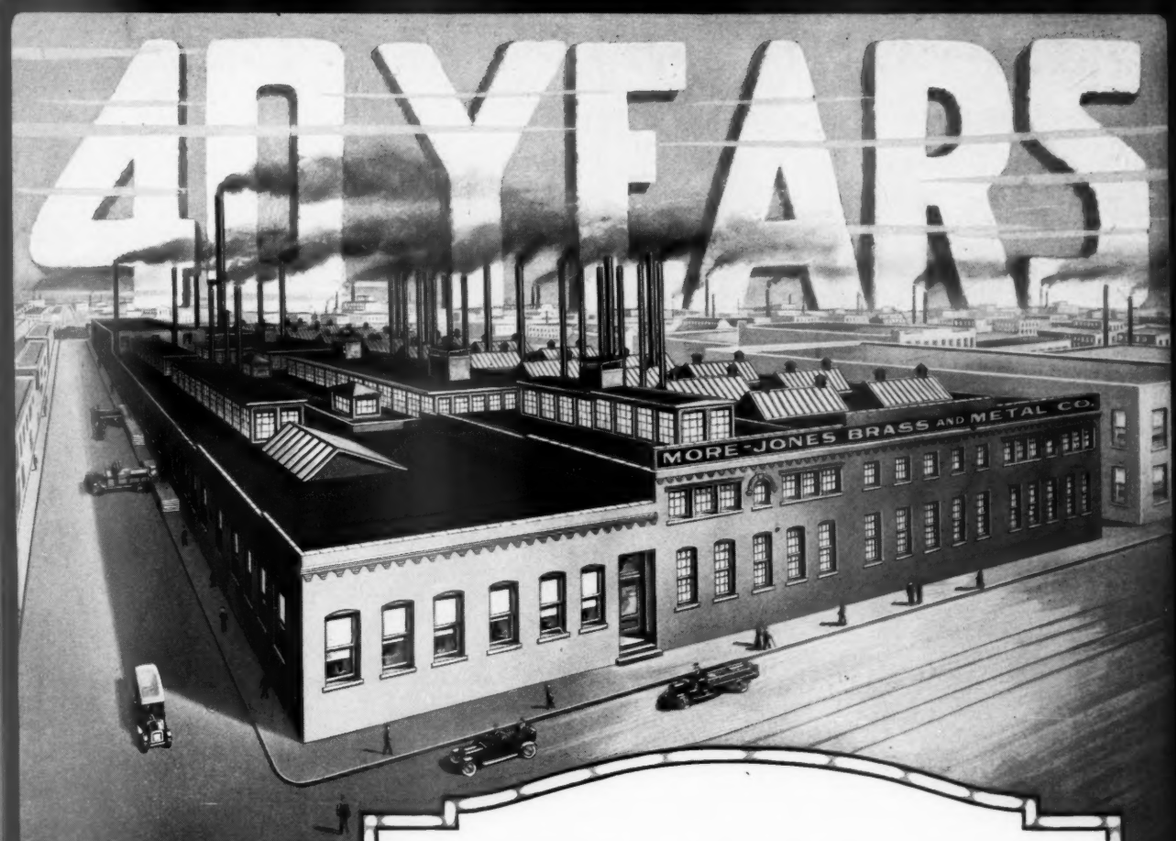


INTERLOCKING

KING
Metallic Piston Rod and Valve Stem Packings

though of the simplest design are of rugged construction—insuring satisfactory service under the most severe conditions at the lowest maintenance costs.

The United States Metallic Packing Co.
Philadelphia, Penna.



OVER forty years of laboratory study and practical foundry experience are behind the MORE-JONES line of railroad specialties.

Our research department has accumulated knowledge relating to the mixing and treatment of metal alloys that is unsurpassed. We have originated many valuable combinations. We have developed an exclusive process of casting bearing structures which are unequalled in strength and wearing qualities. Our materials are the highest grade—our manufacturing methods careful and accurate.

We have investigated the problems affecting both steam and electric roads in the closest and heartiest co-operation with the mechanical experts of various large systems. The most practical ideas that intelligent experiment and exhaustive tests have shown will lead to greater efficiency, longer service and reduced maintenance cost have always been sure of incorporation into MORE-JONES products.

Our experience and knowledge are at your disposal. We invite inquiries on our specialties.

More-Jones Brass & Metal Co., 3132 No. Broadway, St. Louis, U. S. A.

The Line Includes

"Arctic" Bronze Crown Bearings

"Arctic" Bronze M. C. B. Journal Bearings

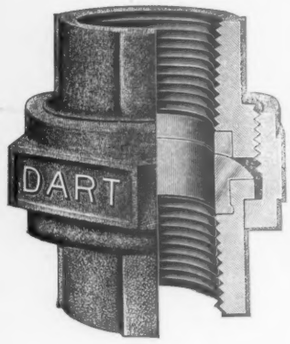
"Tiger" Bronze Rod Brasses and Bushings

Crosshead Gibbs

Hub Liners

MORE-JONES BRASS & METAL Co.
ST. LOUIS, U.S.A.

DART UNIONS



Outlast The Pipes They Join

The two bronze-to-bronze seats, ground together, make an accurate fit and eliminate all possibility of corrosion. Extra heavy malleable pipe ends surmounted by a heavy swivel tightening nut, make the Dart Union a single, unleaking unit.

We'll be glad to send you a Dart Union FREE. Tell us what size you want.

E. M. DART MFG. COMPANY
Providence, R. I.
The Fairbanks Co., Sales Agents
Canadian Factory, Dart Union Co., Ltd., Toronto, Canada

SHERWIN-WILLIAMS CAR ROOF FINISHES

Your car roofs need the proper kind of treatment. We want to help you get best results in painting your car roofs. A car roof paint must produce a tough, yet elastic film of close texture, free from defects. It must be able to withstand exposure to the elements and other destructive agents.

Apply Sherwin-Williams Car Roof Finishes the next time you paint or repaint your car roofs and they will be as durable and lasting as it is possible to make them. Canvas Roof Preservative Primer on New Canvas eliminates cracking of canvas car roofs. We will gladly send further information to anyone interested.

THE SHERWIN-WILLIAMS CO.
PAINT AND VARNISH MAKERS

Address inquiries to

601 Canal Road, N. W., Cleveland, Ohio

4

SMOOTH-ON

TRADE MARK- REG.U.S. PAT.OFF.

IRON CEMENTS

Positively stop all leaks of steam, water, fire or oil in iron, steel or concrete.

They are easy to apply, harden quickly and make permanent repairs, proved by years in use

Every engineer should have a copy of our instruction book.

Smooth-On Iron Cements are sold by supply houses

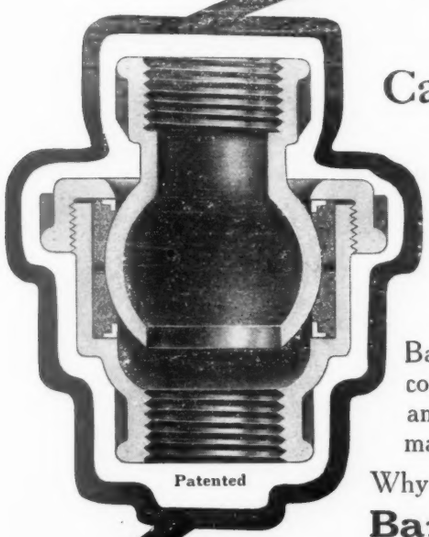
SMOOTH-ON MFG. CO.
Jersey City, N. J., U. S. A.

Send for New No.16 Illustrated Instruction Book

STUCKI SIDE BEARINGS

during the past eight years performed their duties promptly no matter how hard the service was.

A. STUCKI COMPANY
Oliver Bldg. Pittsburg, Pa.



Barco Joints

Can be adapted to all conditions

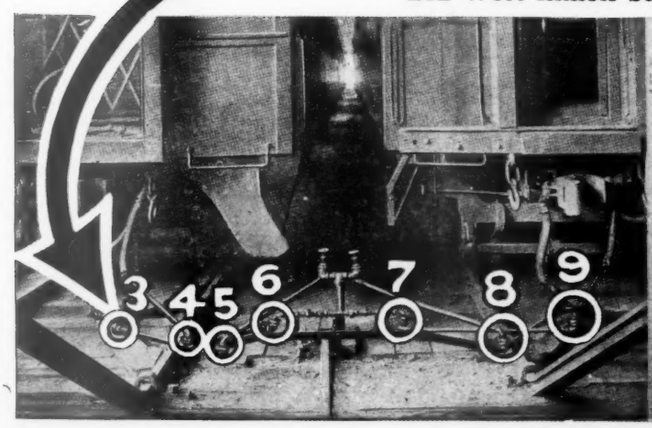
It makes no difference whether the cars back in or whether the installation is to be made on the thru track, side track, or in the coach yard, Barco Metallic Connections meet every condition of service for car heating and for supplying air in terminal stations. When not in service, Barco connections can be folded into very small space, or extended down the track.

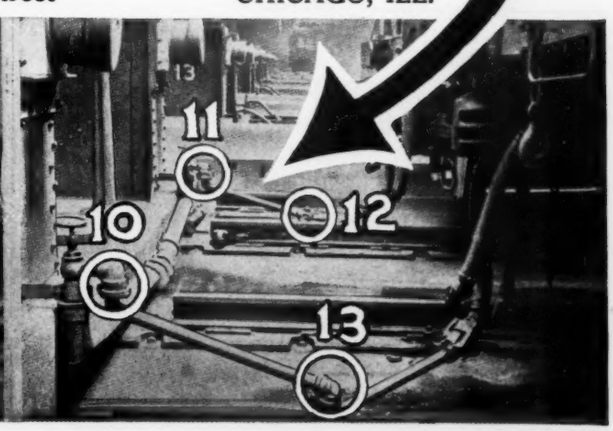
Barco Metallic Connections are always on the job—weather conditions have no effect on them. You can install them and forget them except when you count up the economies in maintenance costs over rubber hose.

Why not look up a few Barco Installations and ask questions?

Barco Manufacturing Company

212 West Illinois Street **CHICAGO, ILL.**





The E. S. B. Constant Voltage Axle Lighting System

is a combination of a good system and a good battery. Maximum battery life, long intervals between cleanings, infrequent flushing and the elimination of adjustments are some of its distinct advantages.

THE ELECTRIC STORAGE BATTERY CO.

1888—PHILADELPHIA, PA.—1917

Boston Atlanta Rochester Cleveland Detroit Chicago Denver St. Louis
New York Washington Pittsburgh Minneapolis Kansas City San Francisco Toronto

Vapor Car Heating Co., Inc.

Railway Exchange, Chicago

Successor to

CHICAGO CAR HEATING CO.

STANDARD HEAT & VENTILATION CO., Inc.

HEATING AND VENTILATING APPARATUS FOR RAILWAY EQUIPMENT

STEAM TRAPS—PRESSURE REGULATORS
SAFETY VALVES—STEAM HOSE COUPLERS
EMERGENCY STOVES

CHICAGO NEW YORK BOSTON
WASHINGTON ATLANTA
MONTREAL

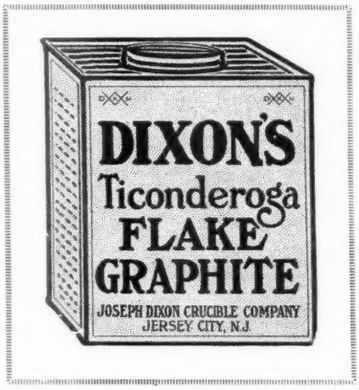
CROSSING THE RUBICON

JULIUS CAESAR took a big chance when he crossed the Rubicon with his veterans from Gaul. He had the courage of his convictions, however, and a loyal army. He immortalized the little river and left his imprint on the institutions of the world.

Many a manufacturer hesitates to make his first venture into the advertising field. Yet he is far better equipped than Caesar when he launched his campaign for an empire.

The manufacturer has every means at hand to ascertain who will read his advertisements—he knows that the RAILWAY MECHANICAL ENGINEER is placed before every wide-awake railway man throughout the country—that in this modern age, every commodity that makes for railway efficiency is examined, analyzed and, if it has real merit, purchased.

RAILWAY MECHANICAL ENGINEER



DIXON'S

Flake Graphite for Steam Cylinder Lubrication

Using Dixon's Flake Graphite for cylinder lubrication means a reduction in the cost of lubrication, combined with better lubrication.

Although Graphite cannot be injected into the cylinders through ordinary lubricators, there are several special devices on the market that successfully feed dry flake graphite or mixtures of graphite and oil. These devices soon pay for themselves by causing a wonderful saving in the cost of lubricants.

Booklet 7-C gives full particulars and information. Send for it.

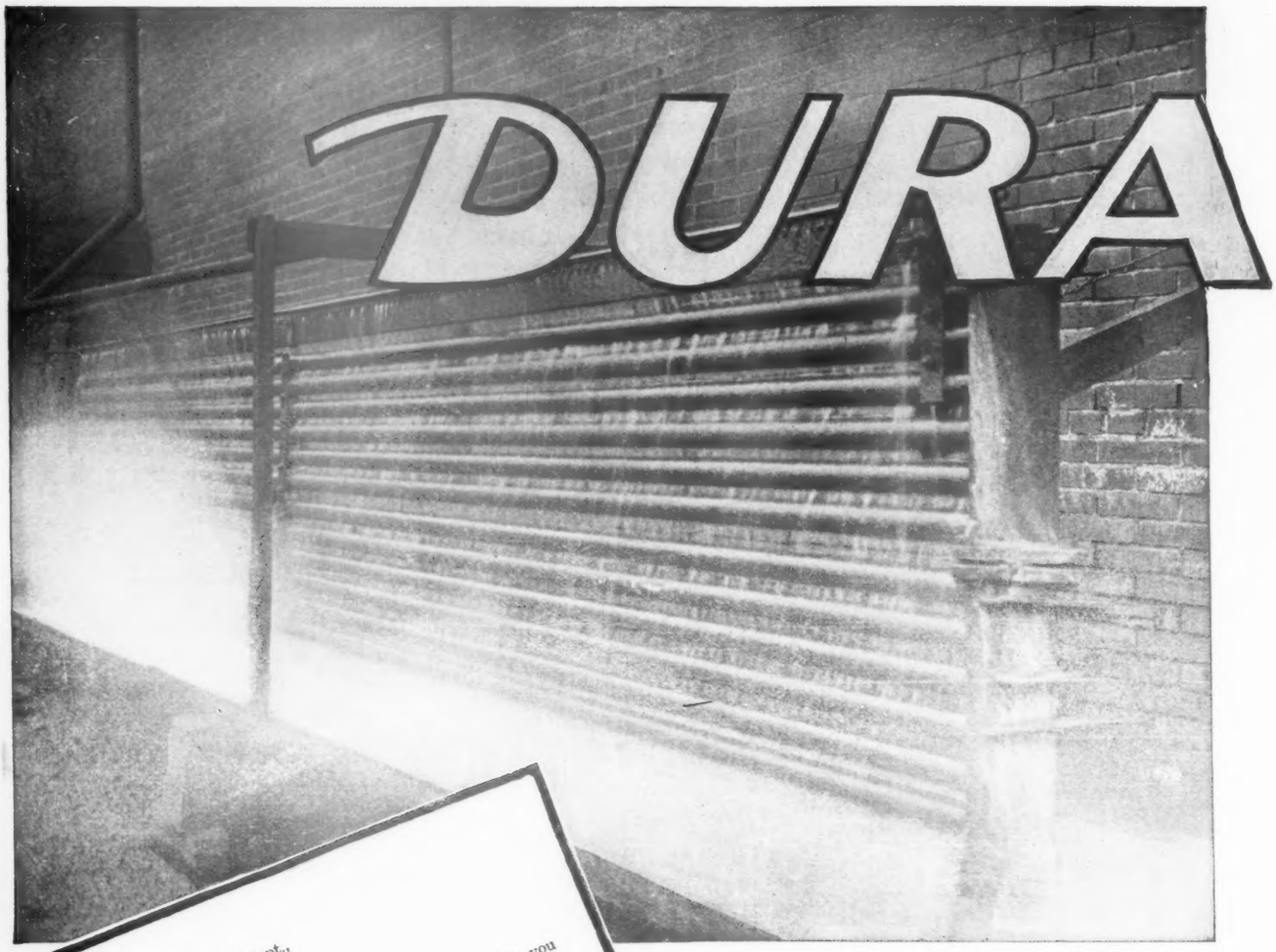
Made in Jersey City, N. J.

Joseph Dixon Crucible Company

D X N TRADE MARK

Established 1827

D X N TRADE MARK



Mr. N. C. Nicol, Met. Dept.,
National Tube Co.,
Pittsburgh, Pa.

Dear Sir:

In reply to your letter of the 3rd inst., I am sending you photograph of the atmospheric condenser which we have in operation here.

The condenser referred to was installed about five years ago, and is, as you are aware, made up entirely of "NATIONAL" pipe. It has been in operation constantly, night and day, and I consider most severe corrosive conditions; as it is located on the roof, exposed to the weather outside of the pipe. During operation the cooling water is heated to a steaming temperature. I mention this, as it is a well known fact that water when heated to high temperature is much more corrosive than when cold.

The name "NATIONAL" which was rolled on each length of pipe, stands out as clearly today as when the pipe was new. From this fact, it is evident that the corrosion has been slight. Also we have not had trouble due to rust-scale forming on outside of pipe, and the only cleaning which we have done is to occasionally brush pipe on the outside with a broom.

As the pipe is subjected to both corrosive action on the outside, which I have mentioned, and also to the action of the condensed steam on the inside, and I has withstood this test without any failures, I am glad to give you this letter for reference.

Yours very truly,
(Signed)_____(*)
Chief Engineer.

*Name and Address Supplied Interested Parties on Request

This installation is in Western New York.

"NATIONAL" Evidence

It pays to be NATIONALly Prepared

¶To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

¶When writing specifications or ordering tubular goods, always specify "NATIONAL" pipe, and identify as indicated.

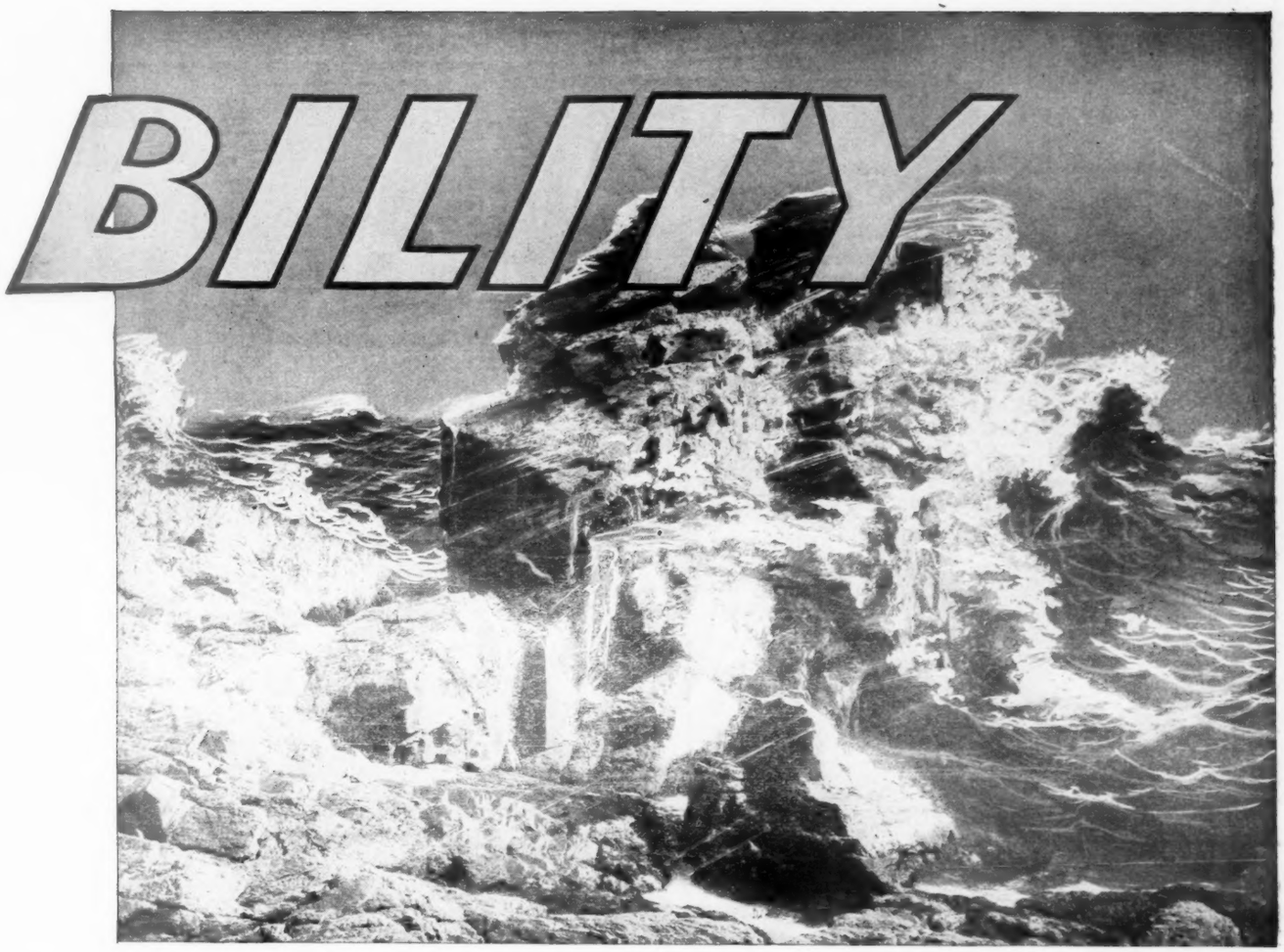
¶In addition, all sizes of "NATIONAL" welded pipe four inches and under are subjected to a rolling knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process National Tube Company has exclusive rights.

¶"NATIONAL" pipe was awarded the GRAND PRIZE (highest possible award) at Panama Pacific International Exposition, 1915.

LOOK FOR THE MARK

NATIONAL

Name Rolled in Raised Letters on National Tube Company Pipe



Pipe and Nature's Rocks Both Durability

¶ Five years' steady service—365 days to the year—24 hours to the day—no rest—no let-up of any kind.

¶ SERVICE EVERY MINUTE.

¶ THAT was what "NATIONAL" Pipe was called on to do and at the end of five years, as mentioned in the chief engineer's letter, (see opposite page), "The name 'NATIONAL' which was rolled on each length of pipe stands out as clearly today as when the pipe was new."

¶ Note also that the service was UNUSUALLY SEVERE.

¶ Again we say: "NATIONAL" Pipe and NATURE'S ROCKS both evidence durability.

NATIONAL TUBE COMPANY, General Sales Offices: Frick Building, Pittsburgh, Pa.

DISTRICT SALES OFFICES:

Atlanta Boston Chicago Denver St. Louis New Orleans St. Paul New York Salt Lake City Philadelphia Pittsburgh

Pacific Coast Representatives: U. S. STEEL PRODUCTS CO., San Francisco, Los Angeles, Portland, Seattle

Export Representatives: U. S. STEEL PRODUCTS CO., New York City

"NEVERBREAK
WALKOVER
CARSEAT"

These three words tell the story of the H & K ALLSTEEL CARSEAT that made the STEEL PASSENGER CAR comfortable, and why it has been used in every first-class Steel Car since the original was built.

HALE AND KILBURN CO.
NEW YORK PHILADELPHIA CHICAGO
DETROIT WASHINGTON LONDON

All kinds of Pressed or Drawn Metal Parts (light or medium), for Governmental, Railway or other purposes. Put your stamping problems up to us—headquarters for

"TRIPLE
UTILITY
STAMPINGS"

Buckeye Cast Steel

Major Couplers
"D" Couplers
Truck Frames
Truck Bolsters
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Draft Yokes

THE BUCKEYE STEEL CASTINGS CO.
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AMERICAN BRAKE SHOE & FOUNDRY COMPANY

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Gold Medal Award, Panama-Pacific Exposition

YOUR MEN WILL APPRECIATE A CLEAN PLACE TO WASH

M. E. & E. CO. WASHBOWLS

Every time each man uses M. E. & E. Co. Washbowls he is absolutely sure of a clean wash free from contamination.

M. E. & E. Co. Individual Washbowls are made for one or two temperatures of water, self-closing or compression bibbs, and in single and double batteries of any number. Any mechanic can make the simple pipe connections required.

SEND FOR OUR COMPLETE CATALOG

showing our line of Washbowls, Metal Lockers, All Steel Stools and Chairs with Inset Wood Seats, Stock and Storage Racks, Metal Shelving, Metal Vault Fixtures, Improved Soda Kettles, 40 and 60 gallons, Water Heaters and Instantaneous Mixers, Bubbling Drinking Fountains, Work Benches and Bench Legs, Drawing Stands, etc.

Manufacturing Equipment and Engineering Co.

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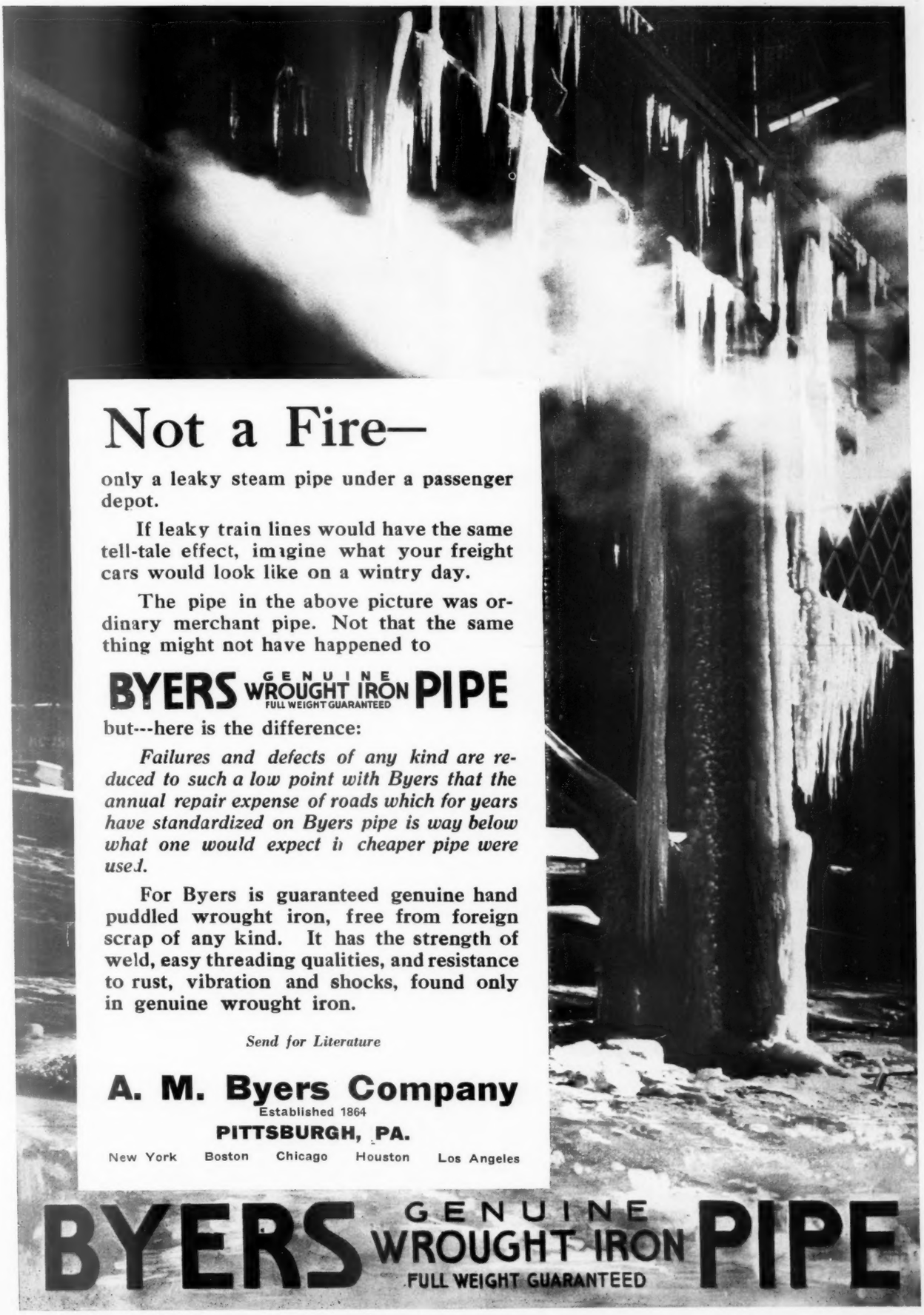
MAIL ADDRESS—Framingham, Mass., U. S. A.



Not a Fire—

only a leaky steam pipe under a passenger depot.

If leaky train lines would have the same tell-tale effect, imagine what your freight cars would look like on a wintry day.

The pipe in the above picture was ordinary merchant pipe. Not that the same thing might not have happened to

BYERS GENUINE WROUGHT IRON FULL WEIGHT GUARANTEED **PIPE**

but---here is the difference:

Failures and defects of any kind are reduced to such a low point with Byers that the annual repair expense of roads which for years have standardized on Byers pipe is way below what one would expect if cheaper pipe were used.

For Byers is guaranteed genuine hand puddled wrought iron, free from foreign scrap of any kind. It has the strength of weld, easy threading qualities, and resistance to rust, vibration and shocks, found only in genuine wrought iron.

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A. M. Byers Company
Established 1864
PITTSBURGH, PA.
New York Boston Chicago Houston Los Angeles

BYERS GENUINE WROUGHT IRON FULL WEIGHT GUARANTEED **PIPE**

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WORKS:
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MALLEABLE IRON, DEPEW, N.Y.
CAST STEEL, DEPEW, N.Y.

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Gould M. C. B. Couplers.
Gould Vestibules, wide and narrow.
Gould Continuous Platforms and Buffers for wood sills.
Gould Continuous Platforms and Buffers with steel underframing.
Gould Steel Platforms with Friction Buffers.
Gould Friction Draft Gear for passenger equipment.
Gould Trap-Door Rigging.
Gould Journal Boxes.
Gould Malleable Iron Draft Beams.
Gould Twin Type of Draft Gears.
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Cast-Steel End Sills.
Steel Castings.
Gould Friction Draft Gear.

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Go and investigate it personally;
Look above each Pintsch gas lamp,
Observe that each and every one
Bears convincing evidence of the
Efficiency of the **"Globe"**

Lamp Jack

"Globe" Users Know Why. They know "Globe" Service means clear, steady burning lamps and economy.

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Hand Brake Mechanism

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Conforms to all requirements of the Interstate Commerce Commission.

Manufactured and Sold only by Us

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They Saved $10,000 a Year by Replacing Side-Deck Sash and Screen Boards, with Side-Deck Ventilators

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"This matter has been thoroughly investigated and we find that through the application of side deck ventilators, there is a saving of approximately $12.00 in labor and $15.00 in material at each shopping of the cars. . . . A TOTAL SAVING OF MORE THAN $10,000 PER ANNUM."

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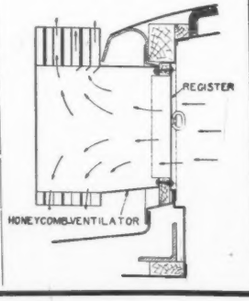
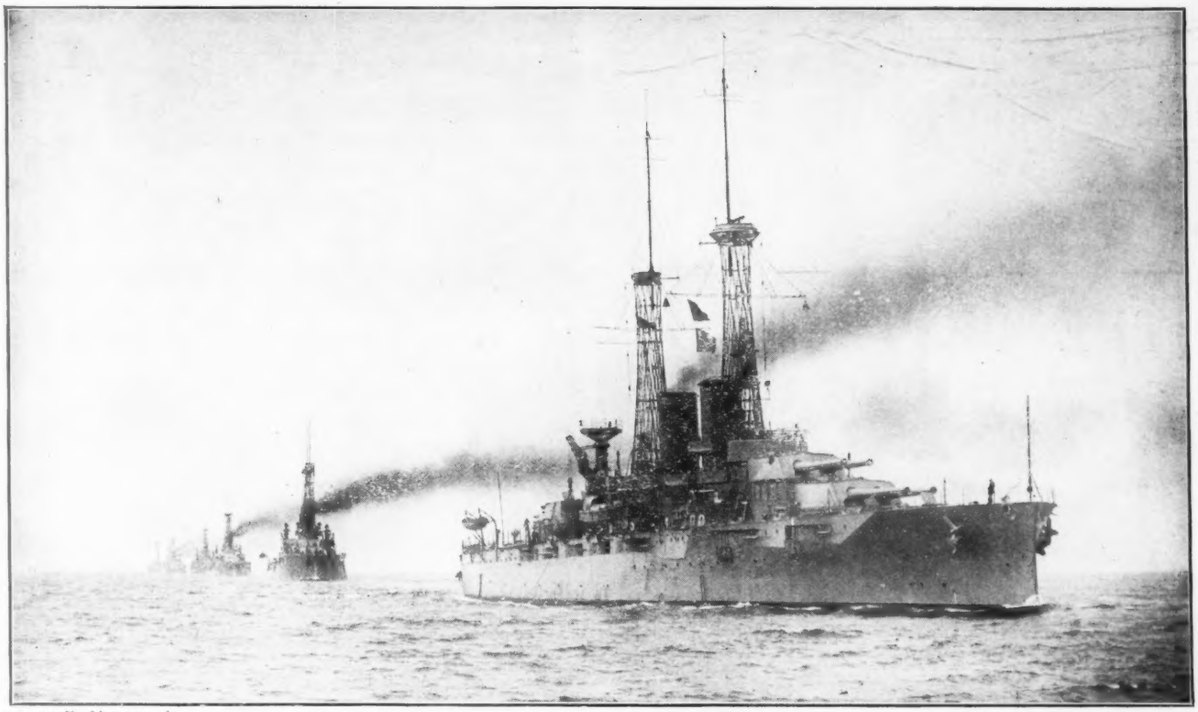
Weatherproof.
Cinder-proof.
Provides good ventilation.
Reasonable in first cost.
Upkeep negligible.





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GLIDING GRANDLY OUT TO SEA, this file of floating fortresses represents the very epitome of Power.

The frowning guns stand for offensive, striking power.

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But almost unnoticed—because unseen—the purring dynamos, the throbbing engines furnish the active cruising power and the energy which turns the turrets with their big guns.

You Engineers know the importance of the Machinery. You realize the dire need for Efficiency below deck. You know that a burned out main bearing, a stopped pump or sticking valves might so impede the forward rush of the ship, that the enemy could outrun and escape her.

But trouble of this kind never happens.

We, of The Texas Company, know this and are proud in the knowing, because all of Uncle Sam's ships are kept running smoothly, efficiently, with Texaco Lubricants.

Today we are supplying to the Navy practically all of the lubricants used on the U. S. naval vessels in all waters, from the oil used to keep the big turbine bearings cool to the lubricant used to ease the mechanism of the Marine's rifle.

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The same high quality in lubricants which we supply to the Navy is available to you anywhere. Tell us your needs. We can supply the lubricant to meet the need.

We shall be glad to send you a pamphlet showing how the Navy tests its lubricating oils and to put you on the mailing list for "Lubrication," a monthly magazine published in the interest of efficient lubrication.

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Dept. M 12, 17 Battery Place, New York City

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Offices in Principal Cities

The Texas Company, Dept. M.E. 12,
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Kindly send me free pamphlet describing Navy tests for lubricants ☐ magazine "Lubrication." ☐ (Check which, or both, if desired.)

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Firm Name.....

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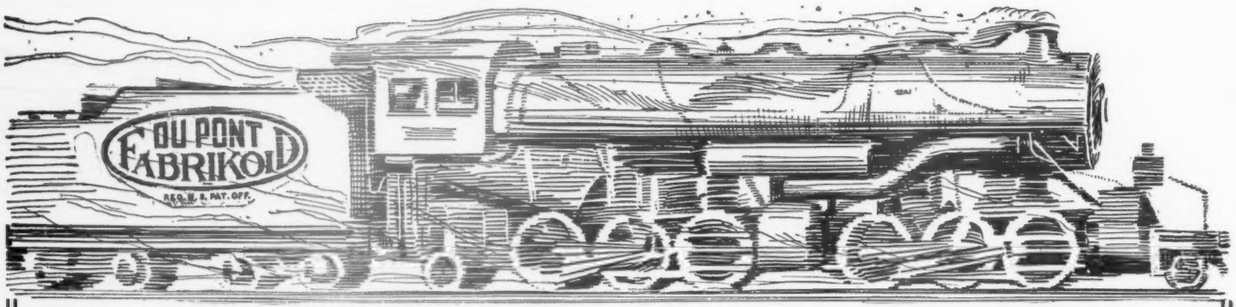
City..... State.....



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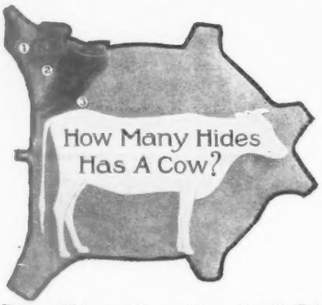
Is Via Du Pont Fabrikoid Upholstery

Fabrikoid Car Seats are

Beautiful
Serviceable
Sanitary



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Let Us Prove This to You with a Small Trial Order

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Our latest development of the M. C. B. Coupler, a modification of our popular Pitt and Janney X Couplers, with latest improvements.

Lock-To-The-Lock
Lock-Set and
Knuckle-Opener

Send for blueprints and prices.

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PITTSBURGH, PA.

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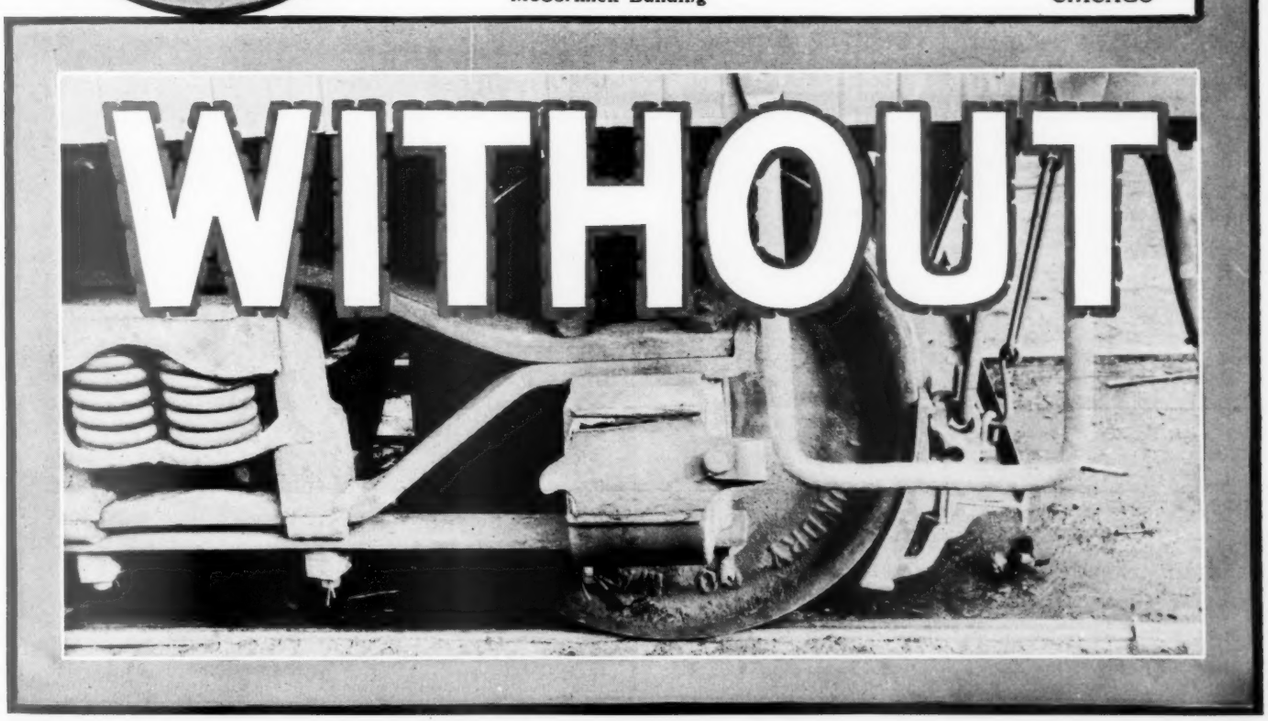
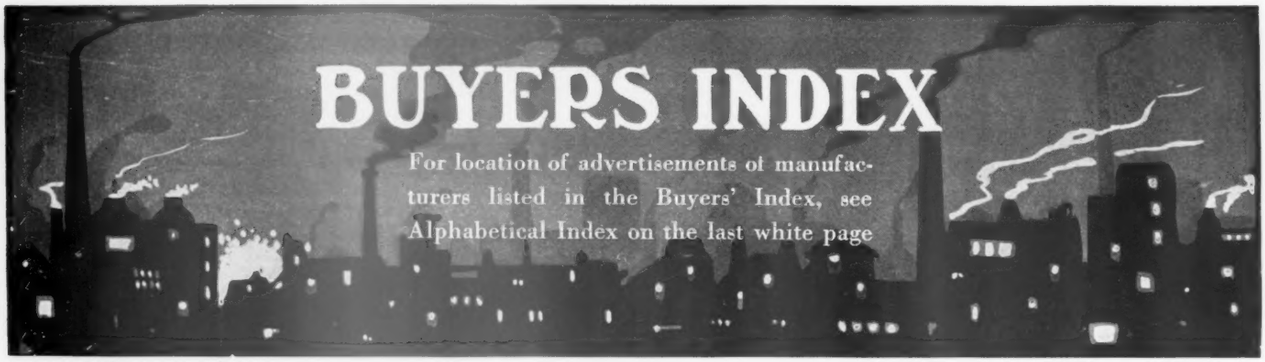
BRAKE BEAM SUPPORT

Conserve your brake shoes!
Insure longer brake shoe wear by giving them proper brake beam support.
The Creco Brake Beam Support prevents 80% of the present waste in brake shoes. It also eliminates the necessity of using safety chains or any other safety-first device on the brake beam.

Chicago Railway Equipment Company
McCormick Building CHICAGO




BUYERS INDEX
For location of advertisements of manufacturers listed in the Buyers' Index, see Alphabetical Index on the last white page

ABRASIVE DISCS.
Gardner Machine Co.
Carborundum Co.

ABRASIVE MATERIAL.
Norton Company.

ACCUMULATORS, HYDRAULIC.
Watson-Stillman Co.

ALLOYS.
Goldschmidt Thermit Co.

ARBORS.
Brown & Sharpe Mfg. Co.

ARCH, LOCOMOTIVE BRICK.
American Arch Co.

ARRESTERS, LIGHTNING.
General Electric Co.

AUTOMATIC RELIEVING LATHES.
Niles-Bement-Pond Co.

AUTOMATIC DIES.
Greenfield Tap & Die Corp.
Jones & Lamson Machine Co.

AXLES.
Carnegie Steel Co.
Lima Locomotive Works, Inc.

BABBITT METAL.
More-Jones Brass & Metal Co.
Ryerson & Son, Jos. T.

BARS, BORING VALVE CHAMBER, BUSHING, PORTABLE.
Rooksby & Co., E. J.
Underwood & Co., H. B.

BARS, LOCO. CYLINDER BORING, PORTABLE.
Pedrick Tool & Machine Co.
Ryerson & Son, Jos. T.
Underwood & Co., H. B.

BARS, STEEL.
Ryerson & Son, Jos. T.

BATTERIES, ELECTRIC.
Electric Storage Battery Co.

BEARING METALS.
More-Jones Brass & Metal Co.
Ryerson & Son, Jos. T.

BEARINGS, JOURNAL.
More-Jones Brass & Metal Co.

BEARINGS, SIDE.
American Steel Foundries.
Chicago Ry. Equipment Co.
More-Jones Brass & Metal Co.
Simplex Railway Appliance Co.
Stucki Company, A.

BELL RINGERS.
United States Metallic Packing Co.

BENCHES, WORK.
Manufacturing Equip. & Eng. Co.

BENDING MACHINES.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.

BENDING ROLLS.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Wickes Bros.

BEVELS, UNIVERSAL.
Brown & Sharpe Mfg. Co.
Starrett Co., L. S.

BLACKSMITH SHOP EQUIPMENT.
National Machinery Co.

BOILER COMPOUNDS.
Dearborn Chemical Co.
Perolin Railway Service Co.
United States Graphite Co.

BOILERS, GRAPHITE.
United States Graphite Co.

BOILERS, LOCOMOTIVE.
American Locomotive Co.
Baldwin Locomotive Works, The.

BOILER METAL TREATMENTS.
Perolin Railway Service Co.

BOILER SHOP MACHINERY.
Landis Machine Co., Inc.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

BOILER WASHERS AND TESTERS.
Nathan Mfg. Co.
Sellers & Co., Inc., Wm.

BOLSTERS, CAR.
American Steel Foundries.

BOLSTERS, STEEL.
Commonwealth Steel Co.

BOLSTERS, TRUCK AND BODY.
Simplex Railway Appliance Co.

BOLT CUTTERS.
Acme Machinery Co.
Acme Machine Tool Co.
Foote-Burt Co.
Greenfield Tap & Die Corp.
Landis Machine Co., Inc.
National Machinery Co.
Niles-Bement-Pond Co.

BOLT AND NUT MACHINERY.
Acme Machinery Co.
Ajax Manufacturing Co.
Greenfield Tap & Die Corp.
Landis Machine Co., Inc.
Niles-Bement-Pond Co.

BOLTS AND NUTS.
Ryerson & Son, Jos. T.
Steel Car Forge Co.

BORING BARS (SEE BARS, LOCO. CYLINDER BORING, PORTABLE).

BORING AND TURNING MILLS.
Bullard Machine Tool Co.
Cincinnati Planer Co.
Newton Machine Tool Works.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Underwood & Co., H. B.

BORING MILLS, HORIZONTAL.
Lucas Machine Tool Co.
Newton Machine Tool Works.
Niles-Bement-Pond Co.
Pedrick Tool & Machine Co.

BORING TOOLS.
Armstrong Bros. Tool Co.
Davis Boring Tool Co.
Kelly Reamer Co.

BRAKE BEAMS.
American Steel Foundries.
Chicago Ry. Equipment Co.
Simplex Railway Appliance Co.

BRAKE HEADS.
American Steel Foundries.

BRAKE LEVERS.
Steel Car Forge Co.

BRAKE PINS.
Steel Car Forge Co.

BRAKES, AIR.
Westinghouse Air Brake Co.

BRAKES, ELECTRIC.
Electric Controller & Mfg. Co.

BRAKE SHOES.
American Brake Shoe & Foundry Co.
Buckeye Steel Castings Co.
Railway Materials Co.

BRAKE WHEELS.
National Malleable Castings Co.

BRASSES.
More-Jones Brass & Metal Co.

BRONZE.
More-Jones Brass & Metal Co.

BRUSHES, MOTOR AND GENERATOR.
United States Graphite Co.

BUFFERS, FRICTION.
Gould Coupler Co.

BULLDOZERS.
Ajax Manufacturing Co.
Canton Foundry & Machine Co.
Ryerson & Son, Jos. T.

BURRING MACHINES.
Ajax Mfg. Co.

CABLES.
General Electric Co.

CALIPERS.
Davis Boring Tool Co.
Starrett & Co., L. S.

CARBOX BORING MACHINES.
Niles-Bement-Pond Co.

CARBORUNDUM.
Carborundum Co.

CAR DOOR FASTENERS.
National Malleable Castings Co.

CAR SEATS.
Hale & Kilburn Co.

CARS, FREIGHT (NEW).
Lima Locomotive Works, Inc.

CARS, MOTOR.
General Electric Co.

CAR-WHEEL BORING MACHINES.
Niles-Bement-Pond Co.
Sherritt & Stoer Co., Inc.

CAR WINDOW FIXTURES.
McCord Manufacturing Co.

CAR WHEEL GRINDING MACHINES.
Norton Company.

CASTINGS, BRASS.
More-Jones Brass & Metal Co.

CASTINGS, IRON AND STEEL.
American Steel Foundries.
Buckeye Steel Castings Co.
Commonwealth Steel Co.
Gould Coupler Co.
McConway & Torley Co.
National Malleable Castings Co.

CASTINGS, MALLEABLE IRON.
Buckeye Steel Castings Co.
National Malleable Castings Co.

CASTINGS, STEEL.
American Steel Foundries.

CENTER BEARINGS.
Chicago Ry. Equipment Co.

CENTERING DEVICES.
Niles-Bement-Pond Co.
Pratt & Whitney Co.

CENTER PLATES.
American Steel Foundries.
National Malleable Castings Co.
Steel Car Forge Co.

CENTER PUNCHES.
Brown & Sharpe Mfg. Co.
Starrett Co., L. S.

CHAIRS, DINING AND PARLOR CAR.
Hale & Kilburn Co.

CHARGERS, STORAGE BATTERY.
Lincoln Electric Co.

CHASERS.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Jones & Lamson Machine Co.
Modern Tool Co.

CHUCKING MACHINES.
Brown & Sharpe Mfg Co.

CHUCKS.
Morse Twist Drill & Machine Co.

CLAMPS.
Brown & Sharpe Mfg. Co.
Starrett Co., L. S.

CLAY, FIRE.
Carborundum Co.

COLD METAL SAWS.
Newton Machine Tool Works.
Ryerson & Son, Jos. T.

COMPRESSION SHAFT COUPLING.
Nicholson & Co., W. H.

COMPRESSORS, AIR.
Chicago Pneumatic Tool Co.
General Electric Co.
Ingersoll-Rand Co.

CONDUIT FLEXIBLE.
Franklin Railway Supply Co., Inc.

CONTROLLERS.
General Electric Co.

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Kelly Reamer Co.

COUPLERS.
American Steel Foundries.
Buckeye Steel Castings Co.
Franklin Railway Supply Co., Inc.
Gould Coupler Co.
McConway & Torley Co.
National Malleable Castings Co.

COUPLERS, HOSE.
Ingersoll-Rand Co.
Railway Utility Co.

CRANES.
Niles-Bement-Pond Co.

CRANES, PORTABLE.
Canton Foundry & Machine Co.

CRANES, WALL AND JIB.
Niles-Bement-Pond Co.

CRANK PIN TURNING MACHINES.
Niles-Bement-Pond Co.
Pedrick Tool & Machine Co.
Underwood & Co., H. B.

CURTAINS AND FIXTURES, CAR.
Du Pont Fabrikoid Co.
Pantasote Co., The

CUTTER GRINDERS.
Brown & Sharpe Mfg. Co.
Niles-Bement-Pond Co.
Norton Grinding Co.

CUTTING COMPOUNDS.
Houghton & Co., E. F.

CUTTING OFF MACHINES.
Brown & Sharpe Mfg. Co.
Nutter & Barnes Co.

CUTTING OFF TOOLS.
Armstrong Bros. Tool Co.

CYLINDER BORING MACHINES.
Niles-Bement-Pond Co.

CYLINDER COCKS.
U. S. Metallic Packing Co.

DERRICKS AND DERRICK OUTFITS.
Carnegie Steel Co.

DIE HEADS.
Greenfield Tap & Die Corp.
Landis Machine Co.
Modern Tool Co.

DIES.
Greenfield Tap & Die Corp.
Landis Machine Co., Inc.
Pratt & Whitney Co.

DIES, THREADING, OPENING.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Landis Machine Co.

DISC AND RING WHEELS.
Gardner Machine Co.
Norton Co.

DISC GRINDERS.
Gardner Machine Co.

DISC GRINDERS, PATTERN MAKERS.
Gardner Machine Co.

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THE National Standard for car curtains and car upholstery. Twenty years' service tests have established its superiority to any other curtain material.

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FOR car headlinings and interior trim. A homogeneous waterproof board of great density and tensile strength. It will not warp, blister or separate.

NON-CONDUCTIVE qualities of heat and cold make it peculiarly well adapted for headlining and interior trim for steel fireproof passenger cars, entirely eliminating the disadvantage of steel for interior trim and giving the appearance of wood finish.

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BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers' Index, see Alphabetical Index on the last white page

DOGS, LATHE.
Armstrong Bros. Tool Co.
DOOR FIXTURES.
Railway Utility Co.
DRAFT ARMS.
American Steel Foundries.
DRAFT RIGGINGS AND ATTACHMENTS.
Commonwealth Steel Co.
Union Draft Gear Co.
DRAW BAR YOKES.
Steel Car Forge Co.
DRILLING MACHINES.
American Tool Works Co.
Foote-Burt Co.
Niles-Bement-Pond Co.
Pratt & Whitney Co.
Reed-Prentice Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Sherritt & Stoer Co., Inc.
DRILLING MACHINES (ARCH BAR).
Foote-Burt Co.
Niles-Bement-Pond Co.
DRILLING MACHINES, HORIZONTAL.
Foote-Burt Co.
DRILLING MACHINES, MULTIPLE.
Foote-Burt Co.
Niles-Bement-Pond Co.
Pratt & Whitney Co.
DRILLING MACHINES, RADIAL.
American Tool Works Co.
Niles-Bement-Pond Co.
Reed-Prentice Co.
DRILLS, PORTABLE (ELECTRIC)
Chicago Pneumatic Tool Co.
DRILLS, PORTABLE (PNEUMATIC).
Chicago Pneumatic Tool Co.
DRILLS, ROCK.
Ingersoll-Rand Co.
DRILLS, TWIST.
Morse Twist Drill & Machine Co.
Ryerson & Son, Jos. T.
DRINKING FOUNTAINS.
Manufacturing Equip. & Eng. Co.
DRIVING BOXES.
Keystone Equipment Co.
DRIVING BOXES (LATERAL MOTION).
Keystone Equipment Co.
DRIVING WHEEL CENTERS.
American Steel Foundries.
Commonwealth Steel Co.
DYNAMOS AND MOTORS.
General Electric Co.
Reliance Electric & Eng. Co.
ELECTRIC APPARATUS AND SUPPLIES.
Electric Controller & Mfg. Co.
ELECTRIC LIGHTING AND POWER.
General Electric Co.
Westinghouse Electric & Mfg. Co.
ELECTRIC STEEL CASTINGS.
American Steel Foundries.
ENGINEERS.
Hunt & Co., Robert W.
ENGINES, CRUDE AND FUEL OIL.
Chicago Pneumatic Tool Co.
ENGINES, GAS AND GASOLINE.
Chicago Pneumatic Tool Co.
EXHAUST FANS AND HEADS.
General Electric Co.
EXPANDING MANDRELS.
Faessler Mfg. Co., J.
Nicholson & Co., W. H.
FANS, ELECTRIC.
General Electric Co.
Westinghouse Electric & Mfg. Co.
FILE CLEANER.
Nicholson File Co.
FILES.
Nicholson File Co.
FILES, TOOL MAKING.
Nicholson File Co.
FIRE DOORS, LOCOMOTIVE.
Franklin Railway Supply Co.
FITTINGS, AIR BRAKE.
Steel Car Forge Co.
FITTINGS, GAS-FIXTURE.
Dart Mfg. Co., E. M.
FIXTURES, LOCOMOTIVE FIRE DOOR.
Franklin Railway Supply Co., Inc.
FLANGES.
Dart Mfg. Co., E. M.

MOST of the manufacturers listed in the Buyers' Index are the leaders in their respective lines. All are responsible firms. They deserve your careful consideration when you are in the market for railway equipment and supplies.

FLANGING CLAMPS.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
FLANGING MACHINES.
Hilles & Jones Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
FLANGING PRESSES.
Niles-Bement-Pond Co.
FLUE CLEANING MACHINES.
Ryerson & Son, Jos. T.
FLUE CUTTERS.
Chicago Pneumatic Tool Co.
Faessler Mfg. Co., J.
Pratt & Whitney Co.
Ryerson & Son, Jos. T.
Underwood & Co., H. B.
FLUE EXPANDERS.
Chicago Pneumatic Tool Co.
Faessler Mfg. Co., J.
Pratt & Whitney Co.
Ryerson & Son, Jos. T.
FLUE SHOP MACHINERY.
Ryerson & Son, Jos. T.
FORGES.
Bradley & Son, C. C.
Chicago Pneumatic Tool Co.
FORGES, OIL RIVETS.
Ryerson & Son, Jos. T.
FORGING MACHINES.
Acme Machinery Co.
Ajax Manufacturing Co.
National Machinery Co.
Sherritt & Stoer Co., Inc.
FORGINGS, CAR.
Steel Car Forge Co.
FOUNDRY FACING.
United States Graphite Co.
FOUNTAINS, SANITARY DRINKING.
Manufacturing Equipment & Engineering Co.
FRAMES, TRUCK.
Commonwealth Steel Co.
FUEL OILS.
Texas Company
FULCRUMS, BRAKE BEAM.
American Steel Foundries
FURNACES.
Brown & Sharpe Mfg. Co.
Railway Materials Co.
GAP LATHES.
Bridgeford Machine Tool Works.
Niles-Bement-Pond Co.
GAGES.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Brown & Sharpe Mfg. Co.
Greenfield Tap & Die Corp.
Pratt & Whitney Co.
GAGES — HEIGHT, DEPTH, THREAD, THICKNESS—SCREW, ETC.
Greenfield Tap & Die Corp.
Starrett, L. S., Company
GAGES, PRESSURE AND VACUUM.
Ashton Valve Co.
GAGES, STEAM.
American Steam Gauge & Valve Mfg. Co.
GAGES, WATER.
Nathan Mfg. Co.
GAGES, WHEEL PRESS RECORDING.
Ashton Valve Co.
GASKETS.
McCord Manufacturing Co.
GAUGES, MASTER CAR BUILDERS' STANDARDS.
Pratt & Whitney Co.
GEAR TURNING MACHINE, BEVEL.
Bridgeport Machine Tool Works.
GENERATING SETS.
General Electric Co.
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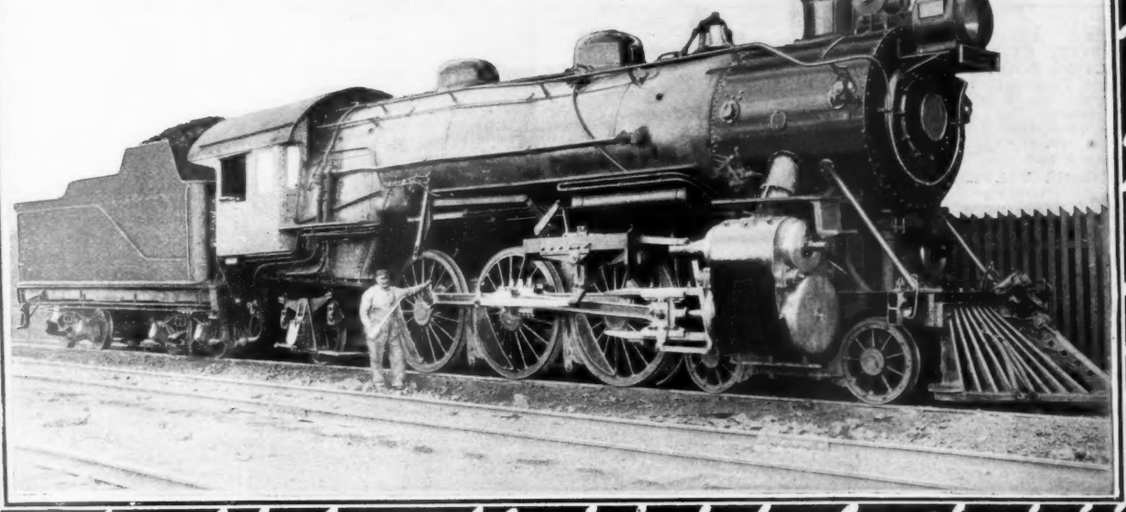

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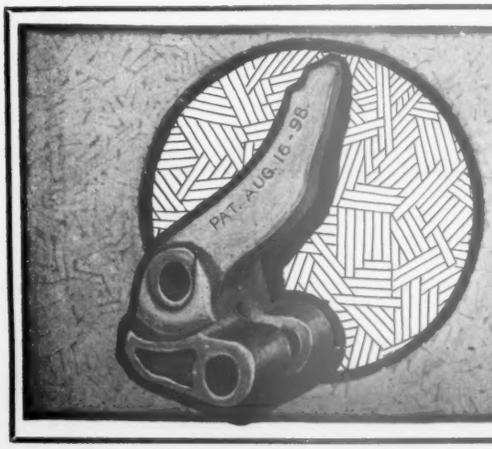

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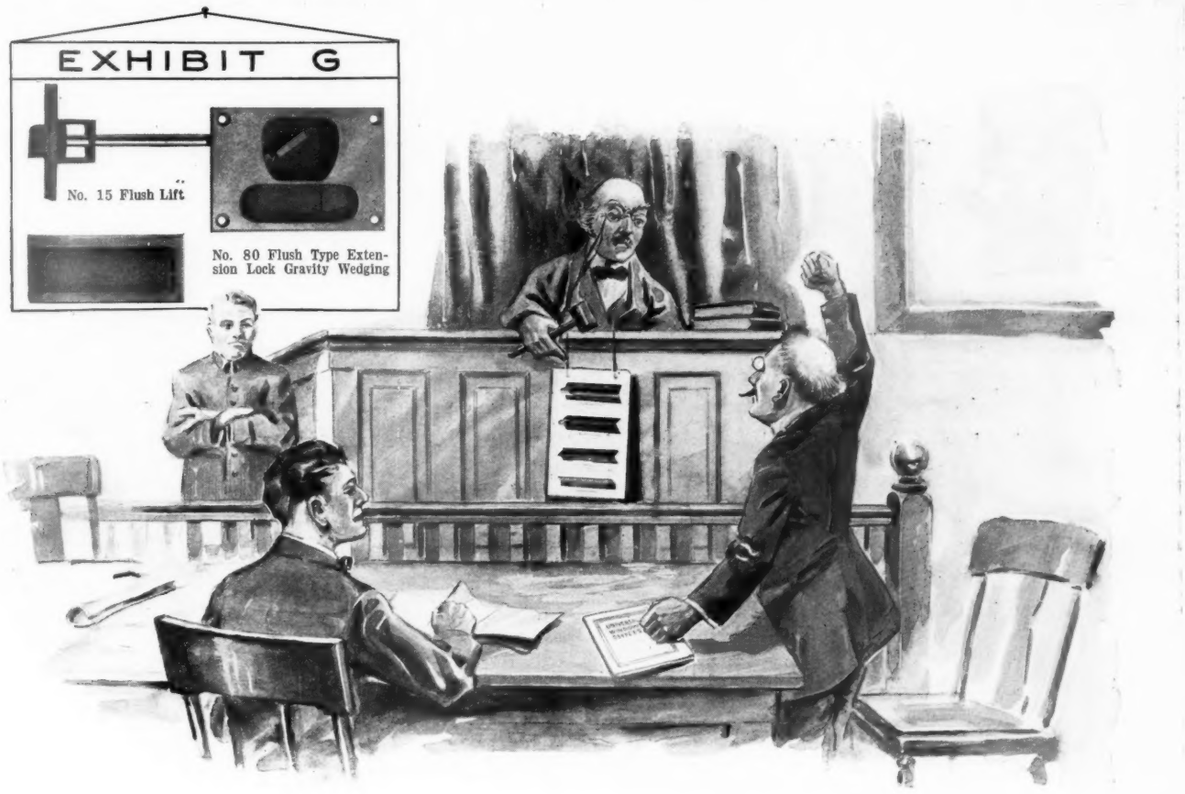

"Win Doe" Trials

"I HAVE noted with regret," said Judge Wrightly, on opening Court, "that there seems to be a tendency on the part of the learned advocate representing the plaintiff to introduce matters that have no real bearing on the case, and also, in fact, if you will pardon the vernacular, a tendency to *knock.*"

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"I object," cried the plaintiff's attorney.

"Out of order," ruled Judge Wrightly.

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"Silence," roared Judge Wrightly.

"Pardon me, Judge," said Win Doe, "not silence, but *noise;* ask the passengers how the windows rattle."

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Cordially,

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By Samuel O. Dunn,
Secretary.

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